Draft-Final

Engineering Evaluation/Cost Analysis for MEC Removal from the Beaches and Roadways of SWMU 4, Former NASD and Munitions Response Areas: Eastern Maneuver Area, Surface Impact Area, Live Impact Area, and Eastern Conservation Area, Former VNTR

Vieques, Puerto Rico

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Executive Summary

This document presents an Engineering Evaluation and Cost Analysis (EE/CA) for a non-time critical removal action (NTCRA) for beaches and roadways of Solid Waste Management Unit 4 (SWMU 4) of the former Naval Ammunition Support Detachment (NASD) and the former Vieques Naval Training Range (VNTR) on Vieques, Puerto Rico. The purpose of this document is to present the interim remedial action alternatives to reduce risks to human health associated with the munitions and explosives of concern (MEC) that exist at the sites.

This EE/CA will be completed as a NTCRA as required by section 300.415(b)(4)(i) of the National Oil and Hazardous Substance Pollution Contingency Plan (NCP; 40 Code of Federal Regulations [CFR] Part 300). Submittal of this document fulfills the requirements for NTCRAs defined by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA). This EE/CA has been prepared in general accordance with the United States (U.S.) Environmental Protection Agency's (USEPA) guidance document *Superfund, Guidance on Conducting Non-Time-Critical Removal Actions under CERCLA*, PB93-963402 (USEPA, 1993).

To address the risks posed by the MEC, alternatives designed to prevent exposure pathways through removal were analyzed. The three alternatives considered for the beaches and roadways are:

1. No Action.
2. Removal of surface and geophysically detected subsurface MEC from select roadways and beaches to detection depth.
3. Removal of surface and geophysically detected subsurface MEC from select roadways and beaches to anticipated depth of intrusive activity.

Alternative 1 serves as a baseline for the evaluation and is not considered a viable option for the site.

Through analyzing the benefits of Alternatives 2 and 3, Alternative 3, removal of surface and detected subsurface MEC from roadways and beaches to the anticipated depth of intrusive activity, was selected as the recommended removal action alternative. This alternative has a high level of efficiency in meeting the remedial action objectives, a relative moderate ease of implementation, and a relative moderate cost. In addition, this alternative would allow the U.S. Fish and Wildlife Service (USFWS) to implement several of the recommendations identified in their preferred land use alternative for the wildlife refuge and wilderness area. Highlights of this alternative include the following:

- Provide access to beaches for wildlife management activities such as monitoring the sea turtle nesting habitats.
- Facilitate management of recreational use for several of the beaches.

- Provide access to selected areas for public use.
- Establish trails along the roadway to provide access to selected sites for wildlife related public uses.

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Acronyms and Abbreviations

AFWTA	Atlantic Fleet Weapons Training Area
ARAR	applicable or relevant and appropriate requirement
ATG	air-to-ground
bgs	below ground surface
CCP	Comprehensive Conservation Plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long -Term Environmental Action, Navy
CSM	conceptual site model
CTO	Contract Task Order
DoD	Department of Defense
DOI	Department of the Interior
DON	Department of the Navy
EBS	Environment Baseline Survey
ECA	Eastern Conservation Area
ECHOS	Environmental Cost, Handling, Options, and Solutions
EE/CA	Engineering Evaluation/Cost Analysis
EIS	Environmental Impact Statement
EMA	Eastern Maneuver Area
EOD	explosive ordnance disposal
FFA	Federal Facility Agreement
ft	feet/foot
GPO	geophysical prove-out
HE	high explosive
IAS	Initial Assessment Study
IC	institutional controls
IRP	Installation Restoration Program
LIA	Live Impact Area
LTM	long-term monitoring
LUC	land use controls
MD	munitions debris
MEC	munitions and explosives of concern
mm	millimeter
MPPEH	material potentially presenting an explosive hazard
MRA	Munitions Response Area
mV	millivolt

NASD	Naval Ammunition Support Detachment
NATO	North Atlantic Treaty Organization
NAVFAC	Naval Facilities Engineering Command, Atlantic Division
NCP	National Contingency Plan
NGFS	naval gunfire support
NRHP	National Register of Historic Places
NSRR	Naval Station Roosevelt Roads
NTCRA	Non-Time Critical Removal Action
O&M	operation and maintenance
OB/OD	open burn/open detonation
OP	observation post
ORS	ordnance-related scrap
PA/SI	Preliminary Assessment/Site Investigation
PI	photo-identified
PRA	Preliminary Range Assessment
PRASA	Puerto Rico Aqueduct and Sewer Authority
PREQB	Puerto Rico Environmental Quality Board
RAO	remedial action objective
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SIA	Surface Impact Area
SWMU	solid waste management unit
U.S.	United States
USEPA	United States Environmental Protection Agency
USFWS	United States Fish & Wildlife Service
USGS	United States Geological Survey
UXO	unexploded ordnance
VNTR	Vieques Naval Training Range

SECTION 1

Introduction

This Engineering Evaluation/Cost Analysis (EE/CA) report was prepared by CH2M HILL under the Naval Facilities Engineering Command, Atlantic Division (NAVFAC), Comprehensive Long-term Environmental Action Navy III (CLEAN III) Contract N62470-02-D-3052, Contract Task Order (CTO) 047. The purpose of the EE/CA is to develop and evaluate remedial action alternatives for removal of munitions and explosives of concern (MEC) from the beaches and roadways of SWMU 4 of the former Naval Ammunitions Support Detachment (NASD) on west Vieques, Puerto Rico, and the former Vieques Naval Training Range (VNTR) on east Vieques.

This document follows the United States (U.S.) Environmental Protection Agency's (USEPA's) guidance provided in document 540/R93/057 *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA* (USEPA, 1993). The SWMU 4 portion of this EE/CA is based on the findings of records reviews and interviews including the Initial Assessment Study (IAS) (Greenleaf/Telesca, 1984), the Environmental Baseline Study (EBS) (PMC, 2000), a Preliminary Assessment/Site Inspection (PA/SI) (CH2M HILL, 2000), and a MEC remedial investigation (RI) conducted January 2002 through July 2003 (CH2M HILL, 2004). The VNTR portion of this EE/CA is based on the findings of records reviews and interviews including the Preliminary Range Assessment (PRA) Report (CH2M HILL, 2003) and the *Revised Draft Expanded Range Assessment and Phase I Site Inspection Report* (CH2M HILL, 2007). The EE/CA assumes that no additional site assessment activities will be necessary to determine the appropriate removal action alternative.

1.1 Purpose and Objectives

This EE/CA provides the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) documentation to support a non-time-critical removal action (NTCRA) as a remedial action for the beaches and roadways of SWMU 4 and the former VNTR. The purpose of this EE/CA is to present the Navy's intent to remove and dispose of the MEC located on the surface and in the subsurface of the beaches and select roadways within SWMU 4 and the former VNTR. The beaches and roadways are being addressed to support the U.S. Fish and Wildlife Service (USFWS) *Final Comprehensive Conservation Plan* (USFWS, 2007) and on-going investigation and removal actions for SWMU 4 and the former VNTR. The chosen interim action will minimize the potential hazards associated with MEC at the areas identified to support current and proposed future use. This EE/CA presents three removal alternatives for this interim action. The final remedy for these areas will be determined as part of the CERCLA process.

Submittal of this document fulfills the requirements for NTCRAs defined by CERCLA, Superfund Amendments and Reauthorization Act (SARA), and the National Oil and Hazardous Substance Pollution Contingency Plan (NCP). This EE/CA has been prepared in accordance with USEPA's guidance document *Guidance on Conducting Non-Time-Critical Removal Actions under CERCLA*, PB93-963402 (USEPA, 1993).

1.2 Regulatory Framework

This document is issued by the U.S. Department of the Navy (DON), in partnership with the USEPA Region II and the Puerto Rico Environmental Quality Board (PREQB), under Section 104 of CERCLA and SARA of 1986.

Section (§)104 of CERCLA and SARA allows an authorized agency to remove, or arrange for removal of, and to provide for remedial action relating to hazardous substances, pollutants, or contaminants at any time, or to take any other response measures consistent with the NCP as deemed necessary to protect public health or welfare and the environment.

The NCP, 40 Code of Federal Regulations (CFR) 300, provides regulations for implementing CERCLA and SARA, and regulations specific to removal actions. The NCP defines a removal action as the

> "cleanup or removal of released hazardous substances from the environment, such actions as may be necessary to monitor, assess, and evaluate the threat of release of hazardous substances; the disposal of removed material; or the taking of such other actions as may be necessary to prevent, minimize, or mitigate damage to the public health or welfare or to the environment, which may otherwise result from a release or threat of release."

For time-critical removal actions, activities shall begin as soon as possible to "abate, prevent, minimize, stabilize, mitigate, or eliminate the threat to public health or welfare of the United States or the environment" (40 CFR §300.415[b][3]). The removal action proposed for the roadways and beaches at SWMU 4 and the former VNTR is non-time-critical.

Title 40 CFR §300.415 requires the lead agency to conduct an EE/CA when a NTCRA is planned for a site. The goals of an EE/CA are to identify the objectives of the removal action and to analyze the effectiveness, implementability, and cost of various alternatives that may satisfy these objectives. An EE/CA documents the removal action alternatives and evaluation and recommendation process.

Community involvement requirements for NTCRAs include making the EE/CA available for public review and comment for a period of 30 days. An announcement of the 30-day public comment period on the EE/CA is required in a local newspaper. Written responses to significant comments will be summarized in an Action Memorandum and will be included in the Administrative Record.

1.3 Organization of the EE/CA

This EE/CA includes the following sections:

- Section 1 - Introduction
- Section 2 – Site Description and Background
- Section 3 – Removal Action Objective and Scope
- Section 4 – Identification and Detailed Analysis of Removal Action Alternatives

- Section 5 – Comparative Analysis of the Removal Action Alternatives
- Section 6 - Recommended Removal Action Alternative
- Section 7 - References

SECTION 2

Site Description and Background

This section presents the background, history (including military operations), and the physical setting of the roadways and beaches of SWMU 4 and the former VNTR. The selection of roadways and beaches at SWMU 4 and the former VNTR was based on the USFWS proposed future land use where the highest amount of traffic is anticipated. In addition, the action will minimize risk posed to unauthorized personnel (e.g., trespassers) who frequent the sites; specifically, the beaches.

2.1 Site Location and Description

Vieques is located in the Caribbean Sea approximately 7 miles southeast of the eastern tip of the island of Puerto Rico and 20 miles southwest of St. Thomas, U.S. Virgin Islands. Vieques is the largest offshore island of the Commonwealth of Puerto Rico. It is approximately 20 miles long and 4.5 miles wide, and has an area of approximately 33,088 acres (51 square miles). Figure 2-1 shows the regional location of Vieques with respect to the island of Puerto Rico.

2.1.1 Former Vieques Naval Training Range

The former VNTR is situated in the eastern half of the Island of Vieques, and is bordered on the west by the community of Isabel Segunda, to the north by Vieques Sound, and to the south by the Caribbean Sea. The former VNTR consists of approximately 14,500 acres and is divided operationally into five munitions response areas (MRAs) that (from west to east) include: the Eastern Maneuver Area (EMA), an area approximately 10,673 acres; the Surface Impact Area (SIA); approximately 2,500 acres; the 900-acre Live Impact Area (LIA), the 200-acre Eastern Conservation Area (ECA) on the easternmost tip of Vieques, and the Beach MRA, which includes all beaches within the suspected MEC impacted area (CH2M HILL, 2006). Figure 2-2 presents a site map of former VNTR.

Because the beaches and select roadways to be addressed as part of the EE/CA are present throughout the five MRAs that make up the former VNTR the following MRA descriptions are presented.

Live Impact Area (MRA-LIA)

In 1965, air-to-ground (ATG) training activity began in the MRA-LIA where several mock-ups, such as old tanks and vehicles, were used as targets for aerial bombing. Since the mid-1970s, naval gunfire was practiced at the MRA-LIA, where several point and area targets for ships were constructed. Based on the naval gunfire and ATG gunfire that occurred from the 1970s through 2003, the entire 900 acres (364 hectares) of the LIA has been impacted by MEC (CH2M HILL, 2006).

Sandy beach areas are interspersed with rocky beaches along the entire south marine boundary of the LIA. Sandy beaches predominate on the northern marine boundary of the

LIA. Rocky beaches are those beaches composed predominantly of boulder sized rock or/and outcropping bedrock.

Surface Impact Area (MRA-SIA)

The SIA was established in the 1950s, when several Marine targets were constructed there. Marine artillery ranging from 76 millimeter (mm) to 175mm were directed toward these targets from artillery gun positions within the SIA and EMA. During 1969, the construction of bulls-eye targets 1 and 2, used for inert bombing, established the eastern and western boundaries of the SIA. At that time, a permanent observation post (OP) with a helicopter pad was also constructed on Cerro Matias. In 1971, a strafing target was installed adjacent to one of the targets. The aerial photo analysis identified numerous craters within the eastern two-thirds of the SIA that were caused by mortar and artillery fire, naval gunfire, and aerial bombing. The craters were most visible on the 1962 aerial photographs. In addition, the aerial photo analysis identified several artillery gun positions and OPs within the SIA that may have been used for artillery fire (CH2M HILL, 2006).

Sandy beach areas are intermix with rocky beaches along the south marine boundary and predominate along the northern marine boundary of the SIA. Yellow Beach lies within the SIA along its southern coast.

Eastern Maneuver Area (MRA-EMA)

The EMA, encompassing 10,673 acres (4,320 hectares), was established in 1947 and provided maneuvering areas and ranges for the training of Marine amphibious units and battalion landing teams in exercises that included amphibious landings, small-arms fire, artillery and tank fire, shore fire control, and combat engineering tasks. The heaviest training events occurred from the mid-1950s until the early 1960s (CH2M HILL, 2006).

In 1966, six ranges were established along the northern coast of the EMA. The Preliminary Range Assessment Report (CH2M HILL, 2003) describes each of these ranges in detail. The descriptions include the current field conditions of the ranges, as well as a summary of the archival data and aerial photo analysis for each range (CH2M HILL, 2006).

An aerial photo analysis identified several artillery gun positions within the EMA from which Marine artillery gunfire was directed toward the SIA and LIA. The artillery fired from the gun positions ranged from 60mm to 175mm. Field inspections of these gun positions were completed in the Preliminary Range Assessment (CH2M HILL, 2003) and the Expanded Range Assessment and Phase I Site Inspection (CH2M HILL, 2007). The aerial photo analysis identified 19 additional gun positions that were used for either mortar or artillery gunfire. The area impacted by MEC within the EMA is estimated to be approximately 6,000 acres (2,430 hectares).

Sandy beaches are predominate on the north marine boundary of the EMA. The south side marine boundary of the EMA is primarily rocky beach with some sections of sandy beach, especially in coves including Red Beach and Blue Beach. Red and Blue Beaches were geophysically surveyed in 2003, and were cleared of subsurface MEC (CH2M HILL, 2003).

Eastern Conservation Area (MRA-ECA)

The ECA, encompassing 200 acres (81 hectares) on the eastern tip of Vieques, was not an operational area for munitions use. However, its close proximity to the LIA, where extensive naval gunfire and ATG bombing took place, identifies the ECA as a potential area for MEC impacts. In addition, the OB/OD area within the LIA generated an explosive safety arc that extended into the ECA (CH2M HILL, 2006).

Rocky beaches predominate on the marine boundary of the ECA; however, one long sand beach exists on the north side, near the boundary of the LIA. Smaller sections of sandy beach exist along the southern boundary.

2.1.2 Solid Waste Management Unit 4

SWMU 4 extends across an area of approximately 100 acres, located on the southwest corner of Vieques. It is situated within the approximate 3,100 acres retained by the U.S. Government as part of the Former NASD land transfer on April 30, 2001 OB/OD units comprising approximately 36 acres on a small ridge, were used for the thermal destruction of retrograde and surplus munitions, fuels, and propellants. Sandy beaches form the marine boundary to SWMU 4.

2.1.3 Geology

The geology of Vieques Island is characterized on the east side by marine volcanic andesites (generally lava tuff and *tuffaceous breccia*) intruded by a plutonic rock complex. These igneous rocks are generally overlain by alluvial deposits with some patches of limestone. The plutonic intrusive rocks consist of granodiorites and quartz-diorites, and are exposed over a large percentage of the island.

The geology of the western side of the island is dominated by the plutonic complex with some overlying alluvial deposits especially near the marine borders. A gradual change in texture from coarse to fine-grained quartz-diorite has been observed from western to eastern Vieques. A saprolite formation occurs at the surface of the plutonic complex in some areas.

Limestone occurs in sectors of the island's northern, southern, and eastern parts. The most extensive areas of limestone are found on the southern coastal peninsulas. The limestone is generally soft, yellowish, and well-indurated where exposed to the atmosphere. The alluvial deposits are generally of Quaternary age, consisting of a mixture of sand, silt, and clay that together have an average thickness of 30 feet (ft) in western Vieques and range from 5 to 50 ft thick on the eastern end of Vieques. The alluvial materials are beach and dune deposits, and swamp and marsh deposits. The beach and dune sands are composed of calcite, quartz, plutonic rock fragments, and minor magnetite (USGS, 1989).

Soils on Vieques Island are primarily residual, due to both climatic and subsurface rock conditions. They typically are classified into five groups and range from rock land soils where bedrock is exposed to deep, well-drained soils within the alluvial deposits to shallow soils (USDA, 1977).

2.1.4 Hydrology

The streambeds found on Vieques flow either northerly or southerly until they reach the Caribbean Sea or Atlantic Ocean. Vieques does not have any perennial surface drainage, and receives an island wide long term average of 45 inches of rainfall per year. The eastern side of the island receives approximately 25 inches/year, while the western side around SWMU 4 averages approximately 50 inches/year. Of the total rainfall, approximately 90 percent is lost to evaporation, based on statistics from the U.S. Virgin Islands. Of the remaining 10 percent, approximately 5 percent infiltrates into the groundwater system and 5 percent becomes surface runoff. (USGS, 1989).

Surface Water

Surface water deposits in the former VNTR occur primarily in coastal lagoons and intermittent streams, known locally as arroyos and quebradas that channel water downward from hills during rain events. Some of these arroyos and quebradas have standing water year-round, especially in areas abutting the coastline where terrain has leveled sufficiently to allow for standing water. Several mid- to large-sized lagoons are present near the Purple Beach area just east of Puerto Negro and to the south within the Ensonada Honda area, the Bahia de la Chiva area, and the South Coast Bays area.

Some rainwater does pool for some time in low-lying areas following storm events, but these features typically dissipate within a few days.

Surface water on the former NASD consists of Arenas, El Pobre, and Kiani Lagoons at the northwestern end of the former NASD, and the Playa Grande Lagoon at the southeastern end (Figure 2-3), as well as intermittent streams. Most of the streams are ephemeral, flowing for only a short time after rainstorms. These streams generally flow in a northerly or southerly direction from the centrally located elevated inland areas (Greenleaf/Telesca, 1984).

Groundwater

The groundwater on Vieques is derived from rainfall. The water flows downhill as intermittent stream runoff or seeps into the soil and underlying deposits. Water in pore space, cracks, and fractures in bedrock eventually flows into alluvial deposits or to the ocean. Yearly variations in island-wide rainfall influence groundwater levels locally. Groundwater levels also exhibit fluctuations near the coastline because of tidal influences.

The groundwater on the island is broken up into two aquifers: the Valle de Resolución, located beneath the island's western portion (the only known groundwater aquifer on the former NASD property that contains potentially potable water), and the Valle de Esperanza located beneath the island's southern portion near Camp Garcia. As discussed above, approximately 5 percent of the annual precipitation infiltrates through the ground and supplies the aquifers. The Valle de Esperanza is the more productive of the two aquifers and, therefore, was used as a source of potable water by the Navy. The Puerto Rico Aqueduct and Sewer Authority (PRASA) managed a series of 16 wells which pumped approximately 450,000 gallons of water per day, although these wells are no longer active because of the installation of a water line from the island of Puerto Rico to Vieques in 1978.

The U.S. Geological Survey (USGS) performed a groundwater study on Vieques, including tests on the wells near Esperanza. The results indicated that the groundwater contained

high concentrations of sodium bicarbonate. Because of its high sodium content, the groundwater on Vieques is not suitable for extended use for irrigation or other potable water use. The high levels of sodium result from sea spray infiltrating into the ground and saltwater entering the groundwater supply through excessive groundwater withdrawal (Vargas, 1995).

2.1.5 Natural Resources

Eastern Vieques

The eastern end of Vieques houses a variety of natural resources in the form of wide-ranging plant and wildlife species. A number of conservation zones have been established in the former VNTR to help protect these valuable resources. A draft Biological Assessment for the LIA (GMI, 2006) has been developed and presents the mitigation measures that will be implemented to avoid impacts to threatened/endangered species during investigation and removal action activities. The approach for expanding the biological assessment to the remainder of the former VNTR and SWMU 4 was submitted to USFWS and portions of the field effort have been conducted. The identified Conservation Zones are:

- The Punta Este Conservation zone, which is located on the southeastern end of the LIA and consists primarily of drought-resistant scrub that no longer can be found elsewhere in Puerto Rico except on Navy property in Vieques.
- The Cayo Conejo Conservation Zone, a small island located southwest of the LIA in the Bahia Salina del Sur area. This area is an important nesting habitat for the endangered brown pelican and one of the last nesting areas for this species in Puerto Rico.
- The Ensonada Honda Conservation Zone, which lies between Blue and Yellow Beaches on the southern coast of Vieques. This area has the best example of lowland forest growth on Vieques and is also home to a variety of extensive mangrove populations that appear to be healthy and expanding.
- The South Coast Bays Conservation Zone, located on the southern coastline of Vieques directly south of the Camp Garcia area and western portions of the EMA. Two bays at this location, Bahia Tapon and Puerto Mosquito, have bioluminescent properties and are a valuable tourism resource for the island.

The intent of the conservation zones is the preservation of these unique areas as important components of the overall environmental health of Vieques.

Sea turtle nesting occurs primarily from February through November. The sea turtles that have been observed on Vieques are the green, leatherback, and hawksbill sea turtles.

Western Vieques

The majority of SWMU 4 is dominated by a dense shrub canopy of thorny shrubs and scattered herbaceous stratum. The two strata combined provide a canopy that covers approximately 75-95 percent of the SWMU 4 area (GMI, 2000). Dominant shrubs identified on the site included *Acacia farnenciana, Prosopis glandulosa, Pithlcellobium dulce,* and *Zanthoxylum brevipes*. Another co-dominant shrub was *Leucaena leucocephala.* The herbaceous stratum was dominated by *Bothriochloa ischaemum, Commelina erecta, C. diffusa,* and *Lasiacis*

divaricata. No endangered or threatened plant species were observed during the field survey (GMI, 2000).

Numerous wildlife species have been observed in the SWMU 4 area. Horse trails are evident throughout the SWMU 4 area and horses are commonly observed at the site. The bird species observed at SWMU 4 and in habitats similar to SWMU 4 consist of coastal forest and shore species. Numerous lizards (*Anolis* species) and the Indian mongoose were also observed at SWMU 4.

A variety of natural ecosystems exist within the vicinity of the SWMU 4 area and western Vieques in general. These natural systems help sustain the natural balance of the environment on the western side of the island and include:

- A series of natural lagoon systems including Laguna Kiani, Laguna Playa Grande, Laguna El Pobre, Laguna Arenas, and Laguna Punta Boca. These lagoon areas provide valuable roosting and nesting areas for a variety of bird species and also are populated by a variety of mangrove species.
- Established conservation zones include the Playa Grande Conservation Zone, the Laguna Kiani conservation Zone, and the Mt. Pirata Conservation Zone. These conservation zones provide important fishery and wildlife habitat and generally have shorelines with healthy mangrove populations.
- Turtle landing and nesting areas.
- Pelican roosting and nesting areas.
- Threatened and endangered plant species.
- Threatened and endangered animal species.
- The Resolucion Valley aquifer.

2.1.6 Cultural Resources

A number of resources exist in the former VNTR that are of interest from a cultural perspective including a number of conservation zones, cultural resources, and prehistoric sites (Indian and Spanish historical sites). A total of up to 300 sites with the potential to contain significant cultural resources exist within Vieques (U.S. Navy, 1999). Seventeen archeological sites and districts on Vieques are currently listed on the National Register of Historic Places (NRHP) based on surveys completed in 1999 by personnel from the Puerto Rico State Preservation Office. One such area is the Puerto Ferro Lighthouse in the EMA, which has been determined to be eligible for the NRHP (TEC, 2002).

Seventeen archaeological sites and districts currently are listed on the NRHP system for Vieques with a number within the property boundaries of the Former NASD and approximately a half dozen on the island's eastern end as shown on a land use map of U.S. Naval facilities on Vieques (GMI, 1996). This information has been confirmed by the review of other cultural resource maps for Vieques recovered during the record search and NRHP web-based searches.

A number of cultural and archeological resources were identified during implementation of the RI at SWMU 4 including:

- Evidence of the historical sugar cane industry (railroad spurs, etc.).
- Evidence of building footprints east of the main site quebrada (flat irons, etc.).
- Significant evidence found of historical farming activities (hoes, spades, and other farming tools).

No native Indian or Spanish settlement evidence (historic or pre-historic sites) were located within the boundaries of the SWMU 4 site. Interviews with residents from Vieques and former Military personnel familiar with western Vieques confirmed the remnants of the sugar cane industry, farming activities, and historical farm housing.

2.2 Site History

2.2.1 General Site History

The sugarcane industry was the major economic base of Vieques during the late 19th century and early 20th century. Several sugarcane operations in Vieques were largely discontinued in the early 1940s when the U.S. Navy purchased large portions of the island. The U.S. Navy primarily used this land to conduct activities related to military training. The eastern end of Vieques Island was used for all aspects of naval gunfire training, including air-to-ground ordnance delivery and amphibious landings, as well as housing the main base of operations for these activities, Camp Garcia.

The western end of Vieques, the Former NASD was utilized by the U.S. Navy Atlantic Fleet for storage of munitions from approximately 1942 to 2001.

Eastern Vieques

Although the island of Culebra was the focal point for naval gunfire in the 1960s and early 1970s, the development of facilities on the eastern end of Vieques was undertaken in 1964, when a gunnery range was established in the LIA. In 1965, the Navy established the LIA, also known as the Air Impact Area, and began construction of OP 1 on Cerro Matias.

By the 1970s, the LIA maintained several targets for aerial bombing including old tanks and vehicles used as mock-ups, two bulls-eye targets and a strafing target. Additionally, several point and area targets for ships to practice naval gunfire support (NGFS) were established in the LIA.

The Environmental Impact Statement (EIS) for Vieques (Tippetts, et al., 1979) provides a detailed discussion on the development of training facilities in the former VNTR leading up to 1979. The former VNTR provided logistics support, scheduling assistance, and facilities for NGFS and ATG ordnance delivery training for Atlantic Fleet ships, North Atlantic Treaty Organization (NATO) ships, air wings, and smaller air units from other allied nations and the Puerto Rican National Guard. The Fleet Marine Force, Atlantic (FMFLANT), conducted training for Marine amphibious units, battalion landing teams, and combat engineering units in the EMA. Occasionally, naval units of allied nations having a presence in the Caribbean and the Puerto Rican National Guard also utilized the EMA.

Adjacent to and west of the SIA, the 10,673-acre EMA (established in 1947) provided maneuvering space and ranges for the training of Marine amphibious units and battalion landing teams in exercises of amphibious landings, small-arms fire, artillery and tank fire, shore fire control, and combat engineering tasks. It is demarcated by the western property line east to the western front friendly-fire line where the SIA begins. Portions of the training areas within the EMA were in continuous use since World War II, when the Navy acquired title to the land, until 2003.

The Atlantic Fleet's ships, aircraft, and Marine forces carried out training in all aspects of Naval gunfire support, ATG ordnance delivery, air-to-surface mine delivery, amphibious landings, small-arms fire, artillery and tank fire, and combat engineering. As part of normal operations, unexploded ordnance (UXO) was cleared periodically from the LIA and destroyed. The Navy also operated a waste munitions open burn and open detonation (OB/OD) facility under a USEPA interim status Subpart X permit within the LIA. Additionally, unserviceable military munitions were periodically received from Naval Station Roosevelt Roads (NSRR) and from the NASD on the West End of Vieques, for demolition at the OB/OD area in the LIA.

Western Vieques

Activities at the Former NASD were directed under the consolidated command of Commander Fleet Air Caribbean, Naval Forces Caribbean, and Antilles Defense Command, whose headquarters are at NSRR. The mission of the Former NASD was to receive, store, and issue all ordnance authorized by NSRR for support of Atlantic Fleet activities. Site operations on the western end of Vieques Island consisted mainly of ammunition loading and storage, and vehicle and facility maintenance, though some training occurred at NASD as well. The U.S. Navy ceased facility wide operations on the former NASD on April 30, 2001, when the land was transferred to the Department of Interior (DOI), Municipality of Vieques (MOV), and Conservation Trust.

The former OB/OD area at SWMU 4 has been described as 200 yards wide by 0.5 miles long, or 36.4 acres (Greenleaf/Telesca, 1984). The IAS (Greenleaf/Telesca, 1984) completed at SWMU 4 indicated that the OB/OD units were used for the thermal destruction of retrograde and surplus munitions, fuels, and propellants from the period of 1969 through 1979. That report also indicated that the OB/OD units at the site may have been used periodically since as far back as the late 1940's.

The retrograde munitions were placed in the open burn area and a squib or other detonator was placed in the waste material. The open burn was then initiated from a safe distance using electrical detonation. Open detonation pits were also identified throughout portions of the SWMU 4 area during previous investigations. These features were generally circular in nature with three to four depressions approximately 20 ft in diameter. These pits were typically surrounded by 2-ft berms at ground surface. During the RI activities additional landscape features, similar to those described above, were identified as potential OB/OD pits. A total of 16 possible OB/OD pits have been identified at SWMU4. Munitions scheduled for disposal would have been placed on a firm level surface within these depressions, donor explosives would be appropriately positioned on all munitions being disposed of. Following positioning of donor charges, they would be primed and typically connected together using detonating cord in a main line/branch line configuration to insure

simultaneous detonation. The main line of the detonating cord would likely be dual primed with electric or non-electric blasting caps, and detonated remotely.

In addition to the OB/OD activities, this location was also used for the treatment of unexploded munitions found around the targets on the EMA. The EMA is located in the eastern portion of Vieques Island on the former VNTR and is not part of the former NASD property. Other explosive materials disposed at SWMU 4 included material from the rework of munitions (e.g., loose powder and primers), ordnance items from the torpedo shop at NSRR, and flares and cartridge-activated devices (Greenleaf/Telesca, 1984).

2.2.2 National Priorities List Listing

In 2003, the Governor of Puerto Rico requested USEPA to list the former VNTR (and NASD) on the NPL. On May 26, 2004, the President of PREQB sent a letter to the Regional Administrator of USEPA acknowledging that USEPA, PREQB, and DOI concurred with the designation of the former Naval facilities of eastern and western Vieques as an NPL site. In addition, a clarification of the Atlantic Fleet Weapons Training Area (AFWTA) was provided and stated that initial areas of PA/SI under CERCLA will focus on "agreed areas" in and around Vieques and Culebra where the Navy conducted operations, including "those waters in and around Vieques where contamination has come to be located." On February 7, 2005, Vieques was placed on the NPL.

As a result of the NPL listing, a Federal Facility Agreement (FFA) is being developed that will be signed by the Navy, USEPA, PREQB and DOI. The purpose of the FFA is to ensure that potential environmental contamination from past activities are adequately evaluated and appropriate remedial actions are implemented, as necessary, to protect human health and the environment. The FFA will also establish the procedural framework and schedule for implementing these activities. With the listing on the NPL and the creation of an FFA, all future environmental restoration activities on Vieques will be conducted under CERCLA, with USEPA as the lead regulatory agency.

2.3 Current and Future Land Use

2.3.1 Eastern Vieques

The former VNTR was transferred to the DOI in 2003 and must be managed by DOI as part of the National Wildlife Refuge System, pursuant to section 1049 of the Nation Defense Authorization Act for Fiscal Year 2002 (Public Law 107–107). In addition, the LIA including the OB/OD Site, must be managed as a wilderness area where public access will be restricted (Public Laws 106–398 and 107–107). A Comprehensive Conservation Plan for the Vieques National Wildlife Refuge has been developed as is done with all other refuges, and outlines its land use plan for managing the refuge. The Department of Interior Fish and Wildlife Service preliminary land use plan for the former VNTR is presented in Figure 2-4. While all military activities have ceased at the former VNTR the U.S. Navy retains responsibility for any MEC and/or environmental concerns that may exist there. Any land use controls such as access restrictions that are planned for the former LIA are expected to be consistent with those established for state and federal wildlife refuges. Since detection and removal methods are not 100 percent effective, it is likely that intrusive activities will

require the support of qualified UXO technicians. The level of support required will depend on the probability of encountering MEC. The need for UXO support should be included in the planning for any intrusive activities.

2.3.2 Western Vieques

Access to the SWMU 4 area is currently restricted, by fences and landscape features, due to the presence of MEC. Access roads are gated and locked with signage indicating the potential danger associated with the area. A chain link fence encompasses a large portion of the 400-acre buffer zone including the shoreline to the south of the site. Vehicle access to the SWMU 4 area is limited to the main access road, which is gated, that originates at the paved road leading to Mt. Pirata.

Since access has been restricted, the site has been managed as a wildlife refuge by the USFWS, Caribbean Division. Although access is restricted and federal police details monitor the site, there is evidence of trespassing, primarily in the form of crabbing equipment. Trespassers have also recently been seen on site rustling wild horses.

The USFWS has prepared a Comprehensive Conservation Plan (CCP)/EIS for the Vieques National Wildlife Refuge that will provide long term guidance for the management and public use of these lands. Future land use scenarios for western Vieques and the SWMU 4 area are addressed in that document. The land use plan for the SWMU 4 has been developed by USFWS and includes an observation tower(s) and associated trails for nature observation and other recreational activities including usage of beaches along the southern boundaries of the site. The DOI Fish and Wildlife Service land use plan is presented in Figure 2-4.

2.4 Previous Investigations

2.4.1 Eastern Vieques

Preliminary Range Assessment

Nineteen MEC areas were investigated within the former VNTR as part of the Preliminary Range Assessment (CH2M HILL, 2003), an analysis of historical aerial photographs, and interviews of personnel identified 43 additional potential MEC areas within the former VNTR boundaries. These areas include five potential ranges, 32 mortar or artillery gun positions, four observation posts, and two munitions storage areas.

The information from the field reconnaissance, archive search and the aerial photo analysis was evaluated to develop the MEC portion of a conceptual site model (CSM) for the former VNTR. The CSM indicated that the entire 900 acres of the LIA had been impacted by MEC from air-to-ground ordnance delivery and naval gunfire. The activities of the LIA have also potentially impacted the 200 acres of the adjacent ECA. The aerial photo analysis identified numerous craters within the entire 2,500 acres of the SIA which were caused by mortar and artillery fire, naval gunfire and aerial bombing. Safety fans developed for the six ranges and several artillery fans within the EMA show that approximately 5,200 acres of the 10,700 acres within the EMA potentially impacted by MEC.

The roads and beaches addressed in this EE/CA are those that are located within the MEC impacted areas of the EMA, SIA and LIA within the former VNTR, and within the boundaries of SWMU 4 in the former NASD.

Expanded Range Assessment and Phase I Site Inspection Report

An Expanded Range Assessment and Phase I Site Inspection (CH2M HILL, 2007) was conducted to prioritize future munitions response actions. The beaches (Beach Area) within the range fan area and MRSs in the MRA-LIA, MRA-SIA, and MRA-EMA were evaluated to determine potential risks posed by MEC at the sites. A summary of the results of the investigation are presented below. The MRS locations are shown on Figure 2-2.

Beach Area A significant surface MEC hazard existed at the Beach Area; however, during the ERA/Phase I SI all surface MEC items with a high explosive hazard were destroyed by open detonation, which significantly reduced the explosive safety risk. The beach portions investigated included the sandy beach from the mean low-tide line to the vegetation line and did not include rocky areas, which in some instances have MEC items present that pose an explosive hazard. The subsurface assessment, using handheld magnetometers, has shown locations of dense subsurface metallic anomalies that may be indicative of subsurface munitions. Other areas along the beaches were free of anomalies or with sporadic detections. The beaches are readily accessible by recreational boaters and the potential exist for an encounter with MEC during intrusive activities, especially if any beaches are to be opened to the public for recreational use. The dynamic nature of the beach areas may expose MEC present in the subsurface.

MRA-LIA The entire portion of the MRA-LIA evaluated during the site inspection showed a high potential for exposure to explosive hazards due to the exposure to surface MEC. The MEC items are highly varied across the site, most exhibit a high explosive hazard due to their type and sensitivity, as well as their densities which were high at all areas investigated. Accessibility to the LIA is moderate to high depending on the area. A subsurface evaluation could not effectively be carried out due to the significant amount of surface metallic interference with any remote sensing geophysical system such as a magnetometer. Beach locations are readily accessible to boaters. These boaters may be able to hike from the beaches to the interior of the LIA along local roads. The roads do have security gates to prevent vehicular traffic from the west, but pedestrians can gain access from the beaches.

MRA-SIA SIA MRS 1 was the only MRS inspected in the SIA as part of the ERA and Phase I SI. A potential for exposure to explosive hazard exists at the MRA-SIA MRS 1 (based on a site inspection of approximately 25 percent of that MRS) based on the high explosive hazard associated with the surface MEC identified at the MRS. However, access to the areas is limited or very difficult due to very dense vegetation and rough terrain (e.g., steep slopes). The subsurface was evaluated at MRS 1 using handheld magnetometers and a total of 30 subsurface anomalies were located, which is only slightly more than 1 anomaly/acre, which is a low density.

MRA-EMA MRSs 1 through 12 were evaluated during the ERA/Phase I SI. Only MRSs 1, 2, and 4 had MEC present. There was one MEC item located at each of these MRSs that required disposal. It is apparent that maintenance of the ranges at MRSs 2 and 4 has been carried out during the history of the ranges. During this investigation the target areas were

evaluated and in both cases the items requiring disposal were found at the fringes of the target areas. Additionally, MRS 2 has a number of targets that appear to be free of MEC based on a visual assessment; however, a thorough investigation of the targets was not conducted (e.g., disassembly and inspection of internal areas).

Expended items and small arms were found at EMA MRSs 3 and 5 through 12. These MRSs all have limited accessibility. MRS 6 is a large area; a number of expended items were located. Though the items were expended, there is a potential for subsurface MEC at MRS 6. EMA MRS 12 had a number of subsurface anomalies identified and could present a hazard.

2.4.2 Western Vieques

The environmental history of SWMU 4 is based on previous investigations conducted from 1984 through 2003. These include findings of records reviews and interviews including the IAS (Greenleaf/Telesca, 1984), an EBS (PMC, 2000), a PA/SI (CH2M HILL, 2000), and a MEC RI conducted January 2002 through July 2003 (CH2M HILL, 2004).

Initial Assessment Study

An IAS was conducted for the Former NASD in 1984 to identify and assess sites posing a potential threat to human health or the environment due to contamination from past hazardous waste operations. At the time of the IAS, SWMU 4 was designated as Site 19, "West Explosive Ordnance Disposal (EOD) Range, Vieques."

Records indicated that the SWMU 4 was the primary disposal area on Vieques. Activities included the disposal of excess and retrograde ammunition and, on a twice-yearly basis, unexploded munitions found around the targets on the EMA. Materials disposed of at the site include 8-inch projectiles fired in the EMA, and 105mm, 106mm, and 175mm duds fired from Punta Cereja. Other sources of MEC included the material from the rework of munitions (loose powder, primers) and munitions items from the Torpedo Shop.

According to record reviews, the EOD range was determined to be in operation from at least 1969 to 1979. Some interviewees, however, had indicated that the site was used since the early 1940s. The range closed to most uses in 1976. It was swept and cleaned up for a 0.5-mile radius by EOD personnel in 1976, and was swept at least two additional times by 1979. The range was fully closed in 1979.

The IAS concluded that based on the extensive cleanup of the area, further study of the site was not warranted.

Environmental Baseline Survey

As a result of the property transfer of the Former NASD to Puerto Rico, an EBS was conducted to disclose factual relevant information regarding the environmental condition of the Former NASD. The EBS was prepared based on information obtained by record reviews, interviews, site reconnaissance, and aerial photographic review.

In general, the records search and interviews were consistent with the IAS. Additional investigations at the site included an aerial photographic review. The aerial photographic review involved evaluation of 12 aerial photographs dating from 1937/1938 to 1999 by a

firm specialized in the analysis of aerial photography. The aerial photographic analysis was used to:

- Track the history of site operations from pre-Navy occupation to present.
- Identify photo-identified (PI) sites (e.g., ground scars, cleared areas, debris piles, possible disposal areas) for further follow-up investigations.

The aerial photograph survey of SWMU 4 indicated 12 PI sites, including two areas of stressed vegetation, two areas of "staining," one area with suspect liquid, one potential trench, and six ground scars that could represent potential OB/OD pit locations.

Preliminary Assessment/Site Investigation

Additional investigations at the site were conducted in April 2000 and included a PA/SI. A second phase of the PA/SI was conducted in June 2000. During the PA/SI, surface and subsurface soil and groundwater samples were collected for laboratory analysis. Results of that effort indicated that explosive-derived constituents were present in surface soils at concentrations above residential risk-based concentrations (USEPA Region III Residential Risk Based Criteria [RBCs]) and soil leachability criteria. Results of the PA/SI were presented in the *Phase I PA/SI Report for the Former NASD* (CH2M HILL, 2000).

As part of the PA/SI efforts at SWMU 4, a MEC avoidance geophysical survey was completed to clear the locations of soil borings and monitoring wells of potential MEC. In addition, the access roads to the sampling locations were cleared of MEC. A Schonstedt fluxgate magnetometer was used to identify potential MEC near the soil boring and monitoring well drilling sites to a depth of 2 ft. A down-hole magnetometer was used during the drilling process to check for potential MEC every 2 ft to a depth of 10 ft.

Additionally, transects were cut through the brush to identify the potential locations of the OB/OD pits. An EOD technician cleared the area in front of the bulldozer during the brush clearing for each transect. The technician performed a sweep with the Schonstedt magnetometer and identified MEC items. After transects were cut, a conventional magnetometry survey was conducted along transects and pads to identify potential areas of subsurface metal.

A total of 61 MEC items were found, including 37 20mm high explosive (HE) projectiles, 16 MK-230 fuses, five small arms, one 60mm mortar fuse, one electrical blasting cap, and one auxiliary booster. Several of the MEC items were identified along a transect that extended along the center of the 40-acre area where the OB/OD area was suspected to be located. The MEC items detected were removed by the EOD technicians and disposed of by Navy EOD personnel.

The primary MEC contamination source at SWMU 4 is MEC and fragments from the incomplete destruction of munitions and explosive residues in the OB/OD process.

Through three phases of investigations at SWMU 4, sixteen OB/OD units have been identified.

The primary MEC release mechanism at SWMU4 is "kick-outs" of UXO and munitions debris from the burn areas and detonation pits. Potential secondary sources include the

ground surface, subsurface, near-coastal waters, and MEC related constituents. Potential transport and migration mechanisms include human activities, run-off, erosion, storm surge, tides/waves, and percolation. Potential exposure media include the ground surface, subsurface, inland surface water/sediments, coastal beaches or near-shore sediment, inland surface waters, groundwater, and subsurface soil. The fence installed around the perimeter of the site restricts potential human exposure routes including direct contact, dermal exposure, and ingestion. Potential receptors include EOD/UXO workers, recreational users, fishermen, wildlife refuge workers, terrestrial wildlife, and aquatic wildlife.

Remedial Investigation

A MEC RI was conducted in three phases from January 2002 through July 2003. The objectives of the MEC RI include identifying the location of the former OB/OD pits, characterizing the nature and extent of MEC that remains on site, and assessing the explosive safety risks associated. During the field investigation, the density and extent of MEC was determined both laterally and vertically to a depth of one ft below ground surface (bgs) within the vicinity of the primary OB/OD units and surrounding acreage. This data was used to characterize the extent of munitions identified at the site and assess the explosives safety hazards associated with the munitions. Details of the RI are documented in the CH2M HILL, April 2004 *SWMU 4 MEC Remedial Investigation Report* (CH2M HILL, 2004)

To meet these objectives, a number of field tasks were completed. Vegetation covering the 90-acre area of investigation was removed to provide easy access for the field investigations. A surface clearance of all MEC identified within the 90-acre study area was conducted to reduce the explosive safety hazard at the site. The EM61-MK2 instrument was chosen to complete the geophysical survey based on the results from the geophysical prove-out (GPO). The geophysical anomaly map covered a total of 87 acres and shows that the densities of metallic items decrease with distance from the OB/OD pits, however, metallic items are present to the limits of the investigation area.

The geophysical investigation identified discrete anomalies as well as numerous areas or clusters of elevated geophysical response. Target lists were generated for each surveyed quadrant. All anomalies that occurred at or above the targeting threshold of 3 millvolts (mV) (as determined during the GPO) were identified using a unique ID number. The target IDs were prioritized by designating the highest amplitude response as the number one target in each surveyed block. A second list was generated which identified approximately 25 targets per 100 ft by 100 ft quadrant for those grids with 25 or more targeted anomalies. Several of these targets were selected to provide a sampling of the anomaly distribution spatially, as well as variable amplitude response.

The geophysical anomaly data confirmed that areas suspected to be used for demolition activities along the west side of the main drainage were highly anomalous, representing large concentrations of subsurface metal. The 16 OB/OD pits indicated on were initially identified as large anomalous features in the north and central portions of the survey area, which corresponded with circular surface depressions that appeared to be indicative of former demolition pits. Intrusive sampling in these large areas of anomalous response revealed MEC and ordnance-related scrap (ORS), as well as barbed wire, fence material, and other non-ORS metallic debris.

Numerous anomalies located at the edges of the survey area indicate that kick-outs from demolition activities likely extend beyond the areas surveyed. MEC and ORS were targeted and recovered along the margins of the investigation area indicating that the area impacted by historical MEC disposal practices likely extends beyond the limits of the investigation. However, the density and magnitude of metallic anomalies decreased significantly at the margins of the investigation area.

Nature and Extent of Munitions and Explosives of Concern Based on the results of the MEC RI, the following conclusions were derived:

- Approximately 23,700 subsurface metallic items were identified within an 87-acre area.
- Sixteen separate locations were identified as potential pits used for OB/OD of munitions.
- The highest densities of subsurface metal items (200- 300 items per grid) were found near the 16 OB/OD pits. The density of the subsurface metal items decreased significantly, to less than 10 items per grid, at a distance of greater than 1,500 ft from the OB/OD pits.
- A total of 11,211 metallic anomalies (about 47 percent of the anomalies identified) were removed from the ground and inspected, to determine if they were munitions items, what type, and if they posed an explosive hazard.
- Approximately 16 percent of the metallic items removed (1,792 items) were found to be munitions items containing high explosives.
- Approximately 20 percent of the metallic items removed were MEC-related, but did not contain explosives.
- Approximately 64 percent of the metallic items removed were non-MEC.
- Over 95 percent of these were small munitions items, consisting of either 20mm projectiles or small arms ammunition.
- Approximately 97 percent of the MEC items identified were found to occur within 7 inches of the ground surface.
- The munitions that were removed for inspection were destroyed by either mechanical destruction or by detonation with explosives in a covered pit. The scrap metal from the items removed and destroyed has been certified to be safe and free of energetic material (explosives) and was processed at a scrap metal recycling facility.
- Based on the findings of the MEC investigation, it is estimated that approximately 2,400 to 3,200 munitions items remain on-site that present a potential explosive safety hazard and the highest density of the munitions items occurs in the immediate vicinity of the 16 potential OB/OD pits, where an average of 200 munitions items per acre are present.
- A statistical analysis of the geophysical data demonstrated that with greater than a 99 percent confidence the extent of subsurface metallic anomalies extends to a maximum distance of 1,900 ft from the OB/OD pit locations. Based on this information the potential aerial extent of the MEC is approximately 180 acres.

- The entire projected aerial extent of the MEC impacted area is located within the fenced area with the exception of the beach area within the 3000 ft radius arc of MEC concern surrounding SWMU 4.

2.5 Evaluation of Risk

2.5.1 Beach Areas, Eastern Vieques

During the ERA/Phase I SI described in Section 2.4.1 above, MEC were removed from the surface of the beaches; specifically, those adjacent to the LIA, ECA, and SIA. During the evaluation a magnetometer survey showed a number of subsurface metallic anomalies, approximately 30 anomalies per acre. Some of the anomalies could potentially be subsurface munitions. The subsurface anomalies were not investigated as part of the ERA/Phase I SI; therefore, during the risk assessment an assumption is made that the items may pose an explosive hazard. Because of the easy access and continued trespassing of the beaches by recreational boaters and other unauthorized personnel there potential of exposure for any intrusive activities. Furthermore, should Fish & Wildlife Service implement their proposed land use of monitoring several of beaches for turtle nesting activities, the wildlife biologists would be at risk during any invasive activities of monitoring turtle nesting areas.

The following observations were made based on the data gathered during the ERA/Phase I SI. The greatest density of subsurface anomalies at the beaches were located adjacent to the MRA-LIA, specifically MRSs 5, 6, 12, and 14. Subsurface anomaly densities are relatively low on the beaches north of the MRA-SIA. Subsurface anomaly densities are low at the beaches along the north MRA-EMA with the exception of beach areas adjacent to MRSs 18, 20, and 21. No apparent pattern was observed from the distribution of high, medium, and low responses at any of the beach areas.

2.5.2 Beach Areas, Western Vieques

As part of the MEC RI, a risk evaluation was completed to evaluate current future adverse explosive safety risk caused by MEC releases from SWMU 4 in the absence of any actions to control or mitigate these releases. In addition, the risk assessment is used to communicate the magnitude of the risk at the site and primary causes of that risk.

The hazard of the MEC present at SWMU 4 was evaluated based on the data collected during the site investigation. The primary source of MEC found at the site are a result of OB/OD activities at 16 potential OB/OD pits, which resulted in MEC at the pit locations and “kick-outs” from the OB/OD operations. Projections of the lateral extent of the MEC at SWMU 4 indicated that the MEC extended at least 2000 ft from the OB/OD pits covering the beaches and roads and trails identified in the USFWS land use plan.

Because of the easy access and continued trespassing of the beaches by recreational boaters and other unauthorized personnel there potential of exposure for any intrusive activities. Furthermore, should the USFWS implement their proposed land use of monitoring several of beaches for turtle nesting activities, the wildlife biologists would be at risk during any invasive activities of monitoring turtle nesting areas.

2.5.3 Roadways

The roadways, specifically, have not been evaluated as part of the ERA/Phase I SI to determine the nature and extent of subsurface metallic anomalies. Although several of the roadways throughout the EMA, SIA, and LIA are located within areas identified as potentially containing MEC; historically there has been no MEC removal of subsurface MEC from the roadways. Several of these roads have been previously surface cleared of munitions. Large portions of the roadway are located on rock outcroppings with most other portions having a shallow overburden above bedrock based on visual observations and the conditions observed during road repair activities. The roadways proposed for subsurface clearance are within the current MEC restricted area and are in many instances in the vicinity of sites with historic MEC use or sites that may have been historically used for MEC related activities. Because the proposed future land use of these roadways in the EMA, SIA, and SWMU 4 would allow access to the public and USFWS, a MEC subsurface clearance would reduce the potential explosive safety risk of these areas. In addition, subsurface clearance of the roads would minimize the explosive safety risk for USFWS Law Enforcement to access the roads and enforce the wildlife refuge regulations across the refuge. During previous and current site operations, many of the roadway surfaces have been cleared of MEC and non-MEC debris. During Navy operations the roads were periodically cleared of MEC and resurfaced with gravel to insure that there would be no exposure to MEC by persons utilizing the roadways.

Roads have been maintained during the TCRA activities. Significant erosion has occurred during the brief period between Navy maintenance and the beginning of the TCRA due to a tropical storm event. No MEC was identified (in the EMA and SIA) by UXO personnel providing avoidance support during support of current removal action activities. The LIA and ECA are designated a Wilderness Area and therefore public access will be prohibited and vehicle traffic in this area will be restricted to USFWS vehicles carrying persons and equipment performing wildlife management functions and to Navy contractors during site cleanup activities.

Erosion due to tropical storms occurs repeatedly in specific areas. The depth of erosion should be considered during any subsurface removal activities in these areas. The areas that are impacted by erosion are consistent from rainfall event to rainfall event and no MEC has been identified during repair of these locations.

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British Virgin Islands

Anegada

U.S. Virgin Islands

Virgin Gorda

Tortola

St. Thomas

St. John

San Juan

Culebra

U.S. Naval Activity Puerto Rico

PUERTO RICO

VIEQUES

WEST VIEQUES
(Former NASD)

EAST VIEQUES
(Former Vieques Naval Training Range & Former Eastern Maneuver Area)

St. Croix

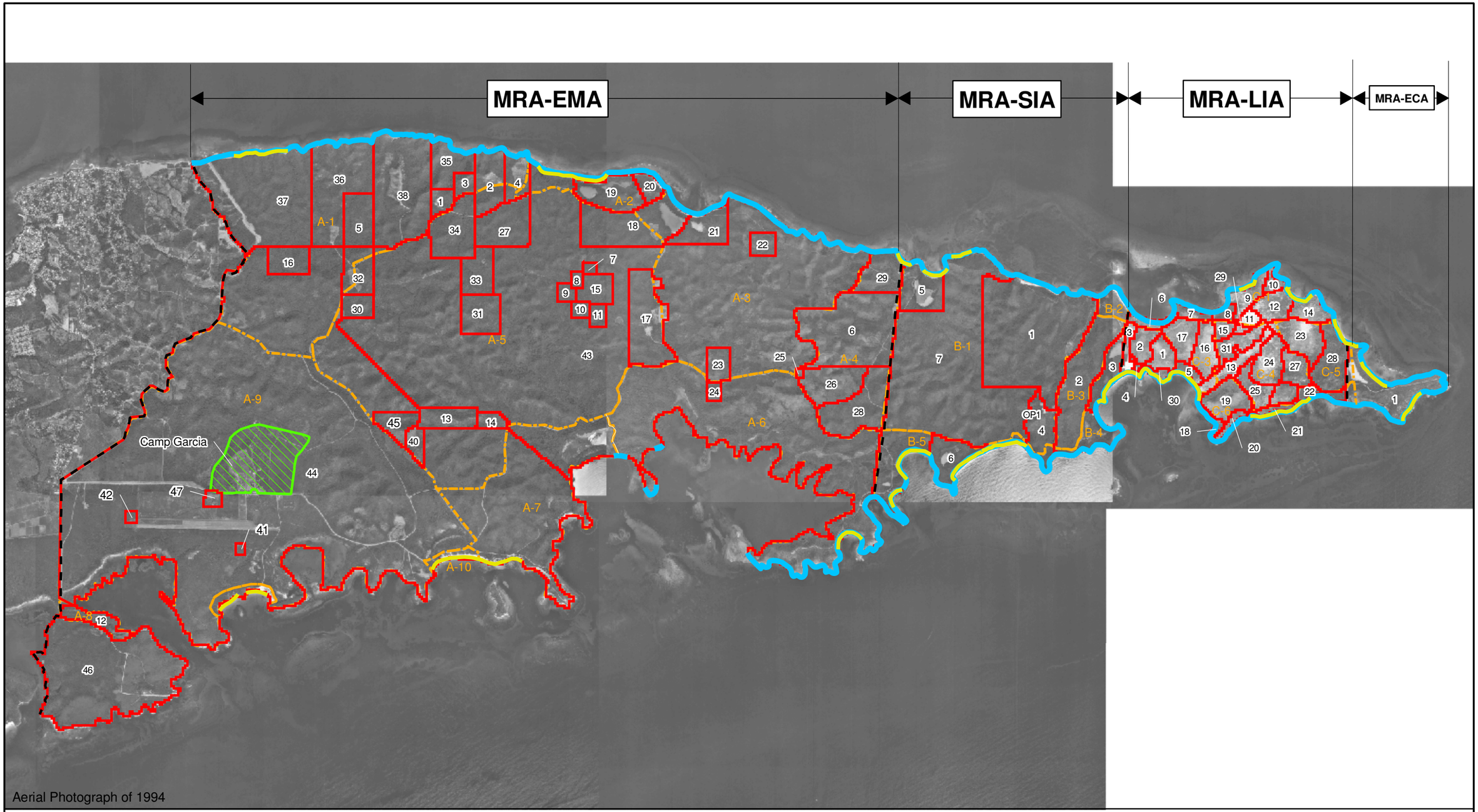
N

Scale in Miles

0 15

Figure 2-1
Regional Location Map
Former VNTR, Vieques, Puerto Rico

CH2MHILL



Legend

- Beach MRS
- Sea Turtle Nesting Areas
- 1 — MRS boundary, MRS number identified
- Parcel Boundary and Designation
- MRA Boundary

Notes :
- MRS Numbers Do Not Signify Priority
- EMA-MRS 43 and SIA-MRS 7 include all terrestrial area within the range fan(s) not designated as other MRSs.
- EMA-MRS 44 includes all terrestrial area outside of range fan(s) not designated as other MRSs.

N W E S

0 625 1,250 2,500 Meters

Figure 2-2
Former VNTR Site Map
Former VNTR, Vieques, Puerto Rico

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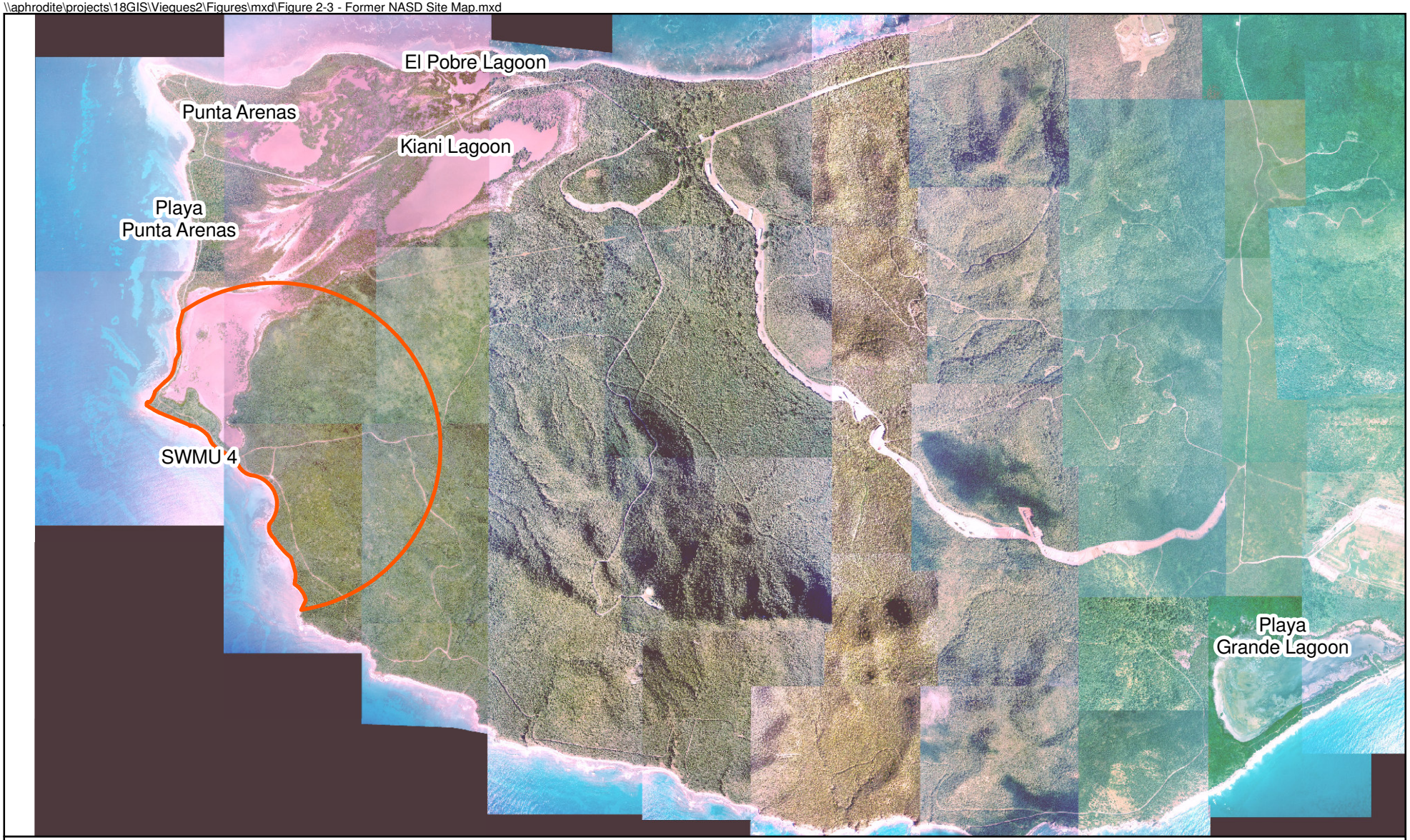
\\aphrodite\projects\18GIS\Vieques2\Figures\mxd\Figure 2-3 - Former NASD Site Map.mxd



Legend

SWMU 4 Boundary

N
W E
S

0 1,250 2,500
Feet

Figure 2-3
Former NASD Site Map,
Vieques, Puerto Rico

CH2MHILL

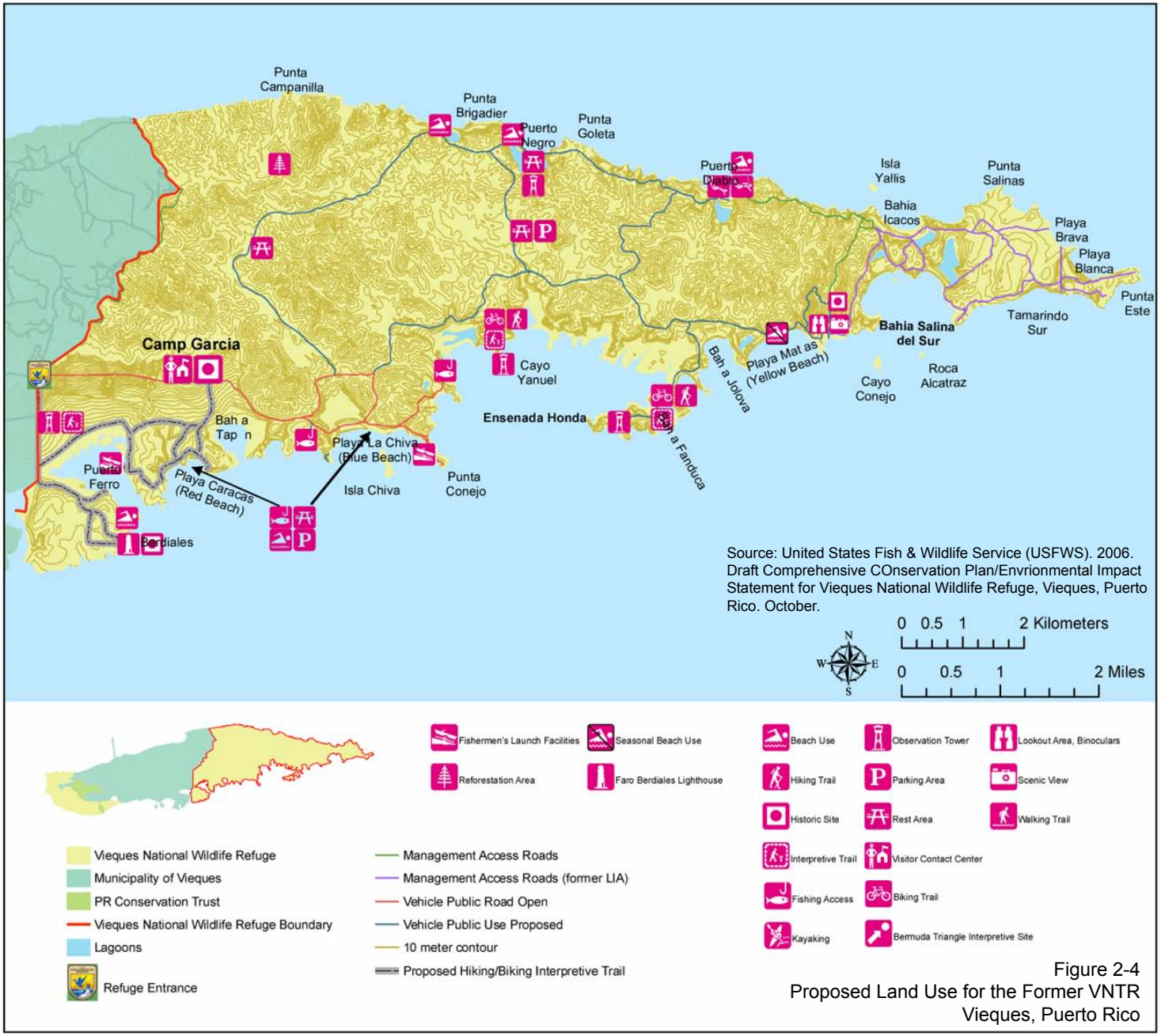


Figure 2-4
Proposed Land Use for the Former VNTR
Vieques, Puerto Rico

Punta Arenas

Laguna Punta Arenas

Laguna El Pobre

Laguna Kiani

Playa Punta Arenas (Green Beach)

Laguna Boca Quebrada

Punta Boca Quebrada

Cerro El Buey

ROTHR Site

Monte Pirata 301 m 987 ft

Laguna Playa Grande

Playa Grande

Punta Vaca

N
W E
S

0 0.125 0.25 0.375 0.5 Kilometers

0 0.125 0.25 0.375 Miles

Source: United States Fish & Wildlife Service (USFWS). 2006. Draft Comprehensive Conservation Plan/Environmental Impact Statement for Vieques National Wildlife Refuge, Vieques, Puerto Rico. October.

- Vieques National Wildlife Refuge
- Municipality of Vieques
- PR Conservation Trust
- Vieques National Wildlife Refuge Boundary
- Relocatable Over the Horizon Radar (ROTHR)
- Lagoons

- Roads
- Proposed Scenic Road
- Site Boundary
- Bridge, Footbridge

- Beach Use
- Biking Trail
- Hiking Trail
- Historic Site
- Interpretive Trail
- Observation Tower
- Parking Area
- Rest Area
- Visitor Contact Center
- Lookout Area, Binoculars
- Scenic View
- Walking Trail

Figure 2-5
Proposed Land Use for the Former NASD, Vieques, Puerto Rico

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\\aphrodite\projects\1BGIS\Vieques2\Figures\mxd\Figure 2-5 - Proposed Land Use for the Former NASD.mxd

SECTION 3

Removal Action Objective and Scope

This section presents information that forms the basis for the site's removal action objectives (RAOs). This information includes statutory limits on removal actions, the removal action objectives and scope, applicable or relevant and appropriate requirements (ARARs), and a discussion of the selection of cleanup criteria.

3.1 Statutory Limits on Removal Actions

The NCP 40 CFR Part 300.415 dictates statutory limits of $2 million and 12 months of USEPA fund-financed removal actions, with statutory exemptions for emergencies and actions consistent with the remedial action to be taken. This removal action will not be USEPA fund-financed. The Navy/Marine Corps Installation Restoration Program (IRP) Manual does not limit the cost or duration of the removal action; however, cost-effectiveness is a recommended criterion for the evaluation of removal action alternatives.

3.2 Removal Action Objective and Scope

3.2.1 Removal Action Objectives

General RAOs are defined by the NCP and as amended by SARA. The NCP requires that the selected remedy meet the following general RAOs:

- Each selected remedial action shall be protective of human health and the environment.
- Onsite remedial actions that are selected must attain those ARARs that are identified at the time of the Record of Decision (ROD) signature.
- Each remedial action selected shall be cost effective; costs shall be proportional to effectiveness.
- Each remedial action shall use permanent solutions and alternative treatment technologies or resource-recovery technologies to the maximum extent practicable. However in the case of this interim action, future actions may be required as part of the permanent solution.

The statutory scope of CERCLA was amended by SARA to include the following general objectives for remedial action at all CERCLA sites:

- Remedial actions shall attain a degree of cleanup of hazardous substances, pollutants, and contaminants released into the environment and of control of further releases at a minimum, which assures protection of human health and the environment.
- Remedial actions where treatment that permanently and significantly reduces the volume, toxicity, or mobility of the hazardous substances, pollutants, and contaminants as a principal element is preferred.

- The least favored remedial actions are those that include offsite transport and disposal of hazardous substances or contaminated materials without treatment where practicable treatment technologies are available.
- The selected remedy must comply with, or attain, the level of any standard, requirement, criteria, or limitation under any federal environmental law or any promulgated standard, requirement, criteria, or limitation under a state environmental or facility citing law that is more stringent that any federal standard, requirement, criteria, or limitation.

The site specific proposed RAO is to implement measures along the beaches and roadways of the former VNTR and at SWMU 4 that will isolate, and reduce MEC explosive hazards from energetic materials that pose a potential explosive safety risk to recreational site users, USFWS wildlife refuge site workers, trespassers, and other authorized personnel/workers, based on current and future land use scenarios.

3.2.2 Removal Action Scope

In the preparation of this EE/CA, three removal action alternatives were evaluated that can meet the objectives listed above. The general scope of each removal alternative evaluated is defined in this section.

The removal action will address the beaches and select roadways at the former VNTR and SWMU 4. All evaluated scenarios will meet the objectives above and will consider the following:

1. Prior to conducting work, measures necessary to protect threatened/endangered flora and fauna (including habitat where warranted) will be implemented in accordance with the Biological Assessment. An approved Biological Assessment addresses the LIA (GMI, 2006). The Biological Assessment is being expanded to the other MRAs and SWMU 4 with a approved approach.
2. A digital geophysical survey will be conducted to identify subsurface metallic anomalies along the selected roadways (including buffer areas; approximately 244 acres) and the beaches (approximately 74 acres in East Vieques on the former VNTR, and approximately 6 acres in West Vieques on beaches of SWMU 4). The geophysical data collection is being conducted as part of the Expanded Range Assessment and Phase II Site Inspection work (CH2M HILL, 2006).
3. MEC surface and subsurface clearance will be completed according to the chosen alternative for the roadways, including a buffer area of 25 ft along each side of the roadway (a total clearance area of approximately 244 acres).
4. MEC surface and subsurface clearance will be completed according to the chosen alternative for the sandy beaches, extending from the mean low tide to the dense vegetation line or inland to the extent of turtle nesting habitat (a total clearance area of approximately 74 acres on the former VNTR and approximately 6 acres on SWMU 4). MEC clearance of the rocky beach areas (approximately 67 acres on the former VNTR) will include only surface clearance of items visible at the surface.

3.3 Determination of Removal Schedule

The EE/CA will be placed in the Administrative Record, and notice of its availability for public review along with a brief summary will be published in the local newspaper. The EE/CA is then available for a 30-day public comment period. Following the public comment period, a Responsiveness Summary summarizing responses to significant comments will be prepared and included in the Administrative Record. Since this removal action has been designated non-time-critical, the start date will be initiated following the resolution of the comments.

The total project period is anticipated to last an estimated 30 months, from the end of the public comment period through completion of removal actions. This is an estimated schedule for project completion, should critical milestones not be met, the total project timeframe would also be extended. Critical milestone periods related to the EE/CA are summarized below:

- EE/CA Public Comment Period—1 month
- Contracting—2 month
- Preparation – 3 months (includes preparation of work plan(s)), ecological resources surveys and evaluations (if required), submittal reviews, and mobilization
- MEC Removal Actions and Demobilization —24 months

3.4 Applicable or Relevant and Appropriate Requirements

The removal action will, to the extent practicable, comply with ARARs under federal and Puerto Rico laws. Appendix A contains the ARAR tables and provides a summary of each potentially related environmental and munitions regulation. Other federal and Puerto Rico advisories, criteria, or guidance will be considered, as appropriate, in formulating the removal action. Applicable requirements are those requirements specific to the conditions at the former VNTR and the surrounding vicinity and SWMU 4 and the surrounding vicinity that satisfy all jurisdiction prerequisites of the law or requirements. Relevant and appropriate requirements are those that do not have jurisdiction authority over the particular circumstances at the former VNTR and surrounding vicinity and SWMU 4 and the surrounding vicinity, but are meant to address similar situations, and therefore, are suitable for use at these sites. Federal ARARs are determined by the lead agency. As outlined by 40 CFR 300.415(j), the lead agency may consider the urgency of the situation and the scope of the removal action to be conducted in determining whether compliance with ARARs is practicable.

The NCP, 40 CFR 300.400(g)(2), specifies the following factors to consider in determining what requirements of environmental laws are relevant and appropriate:

- The purpose of the requirement in relation to the purpose of CERCLA.
- The medium (or media) regulated by the requirement.
- The substance(s) regulated by the requirement.

- The actions or activities regulated by the requirement.
- Variations, waivers, or exemptions of the requirement.
- The type of place regulated and the type of place affected by the release or CERCLA action.
- The type and size of the facility or structure regulated by the requirement or affected by the release.
- Consideration of the use or potential use of affected resources in the requirement.

In some circumstances, a requirement may be relevant to the particular site-specific situation but not appropriate because of differences in the purpose of the requirement, the duration of the regulated activity, or the physical size or characteristic of the situation it is intended to address. There is more discretion in the judgment of relevant and appropriate requirements than in the determination of applicable requirements.

Three classifications of requirements are defined by US EPA in the ARAR determination process: chemical-specific, location-specific, and action-specific. Each is described below.

Chemical-specific ARARs are health or risk management-based criteria or methodologies that result in the establishment of numerical values for a given medium that would meet the NCP "threshold criterion" of overall protection of human health and the environment. These requirements generally set protective cleanup concentrations for the chemicals of concern in the designated media, or set safe concentrations of discharge for remedial activity. Any chemical constituents of concern identified at the munitions response sites will be addressed, as a separate munitions response action, following the reduction of the explosive safety risk by the subsurface removal of munitions.

Location-specific ARARs restrict removal activities based on the characteristics of the surrounding environments. Location-specific ARARs may include restrictions on remedial actions within wetlands or floodplains, the protection of known endangered species, or restrictions for protected waterways. Federal and Puerto Rico location-specific regulations that have been reviewed are summarized in Appendix A.

Action-specific ARARs are requirements that define acceptable treatment and disposal procedures for munitions to ensure the protection of public health and safety. Federal and Puerto Rico action-specific ARARs that may affect the development and conceptual arrangement of removal alternatives are summarized in Appendix A.

SECTION 4

Identification and Detailed Analysis of Removal Action Alternatives

4.1 Alternatives Description

Based on the analysis of the nature and extent of MEC contamination and the cleanup objectives developed in the previous section, three removal action alternatives were developed. The following are the remedial action alternatives considered for detailed evaluation along the roadways and beaches at the former VNTR and SWMU 4:

1. No Action.
2. Removal of Surface and Geophysically Detected Subsurface MEC from Select Roadways and Beaches to Detection Depth.
3. Removal of Surface and Geophysically Detected Subsurface MEC from Select Roadways and Beaches to Anticipated Depth of Intrusive Activity.

A detailed description of each of these alternatives is provided below.

4.1.1 Alternative 1—No Action

The no action alternative implies that no subsurface MEC removal work would be completed at the beaches and roadways. The site would be left as it currently exists where the surface MEC has been cleared from the beaches during the ERA/Phase I SI. Surface clearance of roadways would only be conducted as part of future removal actions for areas where the roadways are part of those sites where an action is implemented.

4.1.2 Alternative 2—Removal of Surface and Geophysically Detected Subsurface MEC from Select Roadways and Beaches to Detection Depth

For purposes of the interim removal action and specific to surface and subsurface removal of MEC from select roadways (including buffer), and beaches:

Anomalies that are selected for investigation will be fully characterized to the depth of detection or the maximum extent practicable, but in some cases it may not be technically practicable to remove the anomaly due to operational or safety considerations [e.g., depth to groundwater, bedrock]).

A review process (including the regulatory agencies) for the anomalies that are to be abandoned will be developed to determine when it is deemed impracticable to remove an anomaly.

Anomalies not fully characterized will be documented in the final report for the interim removal action.

Figure 4-1 presents the areas of proposed MEC removal at the former VNTR as described above. Figure 4-2 presents the area of the proposed MEC removal at SWMU 4 beaches. Table 4-1 presents the phases of work for this alternative. Even though the site will be cleared to the limits of detection, the limits of detection depth with current technology will require land use controls (LUCs) and institutional controls (ICs) to be established restricting future development and access to the site if intrusive activities are planned. Land use controls will consist of creating a land use plan that restricts the type of work that can be done at the site (e.g., restrictions for intrusive activities). The institutional controls will consist of signs that document restricted activities. In addition, a long term monitoring and maintenance program is required to assess if the amount of sand overburden on the beaches is reduced by natural erosion, as erosion of the beaches may create a potential MEC exposure pathway. A majority of the site will not require site restoration (aside from backfilling excavations) following the clearance activities.

TABLE 4-1
Alternative 2—Removal of Surface and Geophysically Detected Subsurface MEC from Select Roadways and Beaches to Detection Depth
Former VNTR Roadways and Beaches, Vieques, Puerto Rico

Operation	Description
Surficial MEC clearance	385 acres would be cleared of all surface MEC, including the rocky beach areas.
Digital Geophysical Mapping	318 acres requiring subsurface removal would be surveyed using digital geophysical mapping equipment.
Beach MEC clearance	74 acres of sandy beach area, including turtle nesting habitat, would be cleared of MEC to the depth of detection.
Roadway MEC clearance	244 acres of roadways (including 25 ft buffer on both sides of the road) would be cleared of MEC to the depth of detection.
Scrap metal segregation, accumulation, and storage	All scrap metal needing to be removed during the MEC clearance would be collected in an accumulation and storage area for off-site disposal. Estimated quantity is 90 tons.
MPPEH/MD certification and disposal	All MPPEH/MD would be documented, removed, and stockpiled until inspection. When certified free of explosives, the material will be transferred to a certified recycling facility. Estimated quantity is 40 tons.
MEC consolidated demolition and demilitarization	All UXO found would be documented and appropriate demolition actions conducted. Estimated quantity is 35 tons.
Site restoration	Any remaining excavation holes would be backfilled. A final cleanup of accumulation areas would be conducted.
Revegetation	All revegetation (if required) would be accomplished by allowing the site to revegetate naturally.

Notes:
ft = foot/feet, MEC = munitions and explosives of concern, MPPEH/MD = Material potentially presenting an explosive hazard/munitions debris, UXO = unexploded ordnance

4.1.3 Alternative 3—Removal of Surface and Geophysically Detected Subsurface MEC from Select Roadways and Beaches to Anticipated Depth of Intrusive Activity

For purposes of the interim removal action and specific to surface and subsurface removal of MEC from select roadways (including buffer), and beaches:

Anomalies that are selected for investigation will be fully characterized to the maximum anticipated depth of intrusive activity plus an additional reasonable depth as a safety buffer between the anomaly and the anticipated depth of intrusive activity (determined on a work area-by-work-area basis) or the maximum extent practicable (in some cases it may not be technically practicable to remove the anomaly due to operational or safety considerations; depth to groundwater, bedrock, etc.). The removal depth (the anticipated depth of intrusive activity plus the reasonable buffer) will be analyzed, determined and documented for each work area in the Work Plan.

A review process (including the regulatory agencies) for the anomalies that are to be abandoned, and are not at the anticipated depth of intrusive activity, will be developed to determine when it is deemed impracticable to remove an anomaly.

Anomalies not fully characterized will be documented in the final report for the interim removal action.

A quality control procedure will be implemented to characterize the detected, but unidentified, anomalies. This procedure will require a subset of the unexcavated anomalies to be randomly selected and excavated irrespective of depth (unless determined to be impracticable due to operational or safety considerations, depth to groundwater, bedrock, etc.). This QC procedure will also be fully detailed in the project Work Plan.

Figure 4-1 presents the areas of proposed MEC removal at the former VNTR as described above. Figure 4-2 presents the area of the proposed MEC removal at SWMU 4 beaches. Table 4-2 presents the phases of work for this alternative. Even though the site will be cleared to the depth of anticipated intrusive activity, the limits of detection depth with current technology will require LUCs/ICs to be established restricting future development and access to the site if intrusive activities are planned. Land use controls will consist of creating a land use plan that restricts the type of work that can be done at the site (e.g., restrictions for intrusive activities). The institutional controls will consist of signs that document restricted activities. In addition, a long term monitoring and maintenance program is required to assess if the amount of sand overburden on the beaches is reduced by natural erosion, as erosion of the beaches may create a potential MEC exposure pathway. A majority of the site will not require site restoration (aside from backfilling excavations) following the clearance activities.

Although a majority of the site will not require site restoration (aside from backfilling excavations) following the clearance activities, the sandy beaches would be restored to the pre-clearance conditions.

TABLE 4-2
Alternative 3—Removal of Surface and Geophysically Detected Subsurface MEC from Select Roadways and Beaches to Anticipated Depth of Intrusive Activity
Former VNTR and SWMU 4 Roadways and Beaches, Vieques, Puerto Rico

Operation	Description
Surficial MEC clearance	385 acres would be cleared of all surface MEC, including the rocky beach areas.
DGM	318 acres requiring subsurface removal would be surveyed using digital geophysical mapping equipment.
Beach MEC clearance	74 acres of sandy beach area would be cleared of MEC to the anticipated depth of intrusive activity.
Roadway MEC clearance	244 acres of roadways (including 50 ft buffer) would be cleared of MEC to the anticipated depth of intrusive activity.
Scrap metal segregation, accumulation, and storage	All scrap metal removed during the MEC clearance would be collected in an accumulation and storage area for off-site disposal. Estimated quantity is 60 tons.
MPPEH/MD certification and disposal	All MPPEH/MD would be documented, removed, and stockpiled until inspection. When certified free of explosives, the material will be transferred to a certified recycling facility. Estimated quantity is 25 tons.
UXO consolidated demolition and demilitarization	All UXO found would be documented and appropriate demolition actions conducted. Estimated quantity is 20 tons.
Site restoration	Any remaining excavation holes would be backfilled. A final cleanup of accumulation areas would be conducted.
Revegetation	All revegetation (if required) would be accomplished by allowing the site to revegetate naturally.

Notes:
DGM = Digital Geophysical Mapping, ft = foot/feet, MEC = munitions and explosives of concern, MPPEH/MD = Material potentially presenting an explosive hazard/munitions debris, UXO = unexploded ordnance

4.2 Detailed Analysis of Removal Action Objectives

Each alternative was evaluated using the effectiveness, implementability, and cost criteria set forth in the NCP and the USEPA guidance for conducting EE/CAs (USEPA, 1993).Each evaluation criterion is described in Table 4-3.

TABLE 4-3
Evaluation Criteria
Former VNTR and SWMU 4 Roadways and Beaches, Vieques, Puerto Rico

Effectiveness	
Protection of human health and the environment	The assessment describes how the action achieves and maintains protection of human health and the environment and achieves site-specific objectives both during and after implementation.
Compliance with ARARs	An alternative is assessed in terms of its compliance with ARARs, or if a waiver is required, how it is justified.
Short-term effectiveness	An action is assessed in terms of its effectiveness in protecting human health and the environment during the implementation of a remedy before removal action objectives have been met. The duration of time until the removal action objectives are met is also factored into this criterion.
Long-term effectiveness and permanence	An action is assessed in terms of its long-term effectiveness in maintaining protection of human health and the environment after removal action objectives have been met. The magnitude of residual risk and adequacy and reliability of post-removal site controls are taken into consideration.
Reduction of exposure to explosive hazards	An action is assessed in terms of anticipated performance of the specific removal technologies it employs. Factors such as volume of MEC removed or destroyed and the degree of expected reductions in exposure to hazards within the removal area.
Implementability	
Technical feasibility	The ability of the technology to implement the remedy is evaluated.
Administrative feasibility	The administrative feasibility factor evaluates requirements for permits, zoning variances, impacts on adjoining property, and the ability to impose institutional controls.
Availability of services and materials	The availability of offsite treatment, storage, and disposal capacity, personnel, services and materials, and other resources necessary to implement the alternative will be evaluated.
State and community acceptance	The acceptability of an alternative to the state (commonwealth) agency and the community is evaluated.
Cost	
Direct and indirect capital costs	Includes costs for MEC removal (excavation and site restoration), equipment and materials, munitions storage and services, engineering and design, and permit/licenses.
O&M costs	Includes ongoing monitoring and maintenance for a specific period.

Notes:
ARAR = applicable or relevant and appropriate requirements, MEC = munitions and explosives of concern, O&M = operation and maintenance

4.2.1 Effectiveness

The *effectiveness* of a technology refers to its capability of removing the specific items in the volumes required, the degree to which the technology achieves the RAO, and the reliability and performance of the technology over time, including protection of human health and the environment, compliance with ARARs to the extent practical, long-term effectiveness and permanence, reduction in explosive safety hazard, and short-term effectiveness.

As explained in Section 2, the RAO for the sites is to implement measures that will isolate, reduce, or eliminate MEC hazards which may contain energetic materials that pose a potential explosive safety hazard to human health and the environment based on current and future land use scenarios.

Levels of effectiveness were assessed based upon the number of "effectiveness criteria" that would be satisfied by each alternative. The "effectiveness criteria" are described in Table 4-3.

Protection of Human Health and the Environment

Alternative 1—No Action. Alternative 1 provides no additional protection to human health and the environment for the former VNTR. The MEC would remain onsite which would potentially expose trespassers and authorized personnel/workers to explosive safety hazards associated with unexploded ordnance. In addition this alternative would not protect the environment from future releases of explosive related contaminants. The current concentration of MEC poses a high explosive safety risk to human health and the environment; this alternative will not reduce that risk.

Alternative 2—Removal of Surface and Geophysically Detected Subsurface MEC from Select Roadways and Beaches to Detection Depth. Alternative 2 provides the highest level of protection to human health and the environment for the former VNTR. Based on the removal of on-site MEC to detection depth, this alternative would reduce the explosive safety risk to humans and the health risk to the environment by removing explosive hazards to the depth detected by the detection equipment. Appropriate LUCs/ICs would still need to be implemented because current detection technology is limited depending on the size and the depth of the MEC item. For example, a 20mm projectile may only be detected to a depth of 6 to 12 inches depending on the geology and item orientation. Therefore, smaller items, such as the 20mm, may be present at depths just below detection. This situation would result in a potential hazard to human health or the environment during an intrusive activity. Additionally, metallic items of significant size may be present at depths below the detection limits of the geophysical system (e.g., tens of feet), which would not likely present an explosive hazard due to the significant depth.

This alternative will increase site restoration efforts and potentially impact conservation areas because of the larger excavations required. Which could influence the landscape through changes in terrain (e.g., drainage patterns).

Alternative 3—Removal of Surface and Geophysically Detected Subsurface MEC from Select Roadways and Beaches to Anticipated Depth of Intrusive Activity. Alternative 3 provides a higher level of protection to human health and the environment for beaches of the former VNTR and SWMU 4 than the No Action alternative. The MEC would be removed and disposed of to the anticipated depth of intrusive activity.

An explosive hazard may still exist in the subsurface due to the limits of current technology to detect metallic items regardless of size or depth. For example, a 20mm projectile may only be detected to a depth of 6 to 12 inches depending on the geology and item orientation. Therefore, smaller items, such as the 20mm, may be present at depths just below detection and within the goal clearance depth. Larger metallic items may be present below the goal depths, but would not be fully investigated because the proposed land use for these areas would result in exposures to explosive hazards only within the depth of clearance.

This alternative would allow USFWS to implement several of the recommendations identified in their land use plan for the wildlife refuge and wilderness area.

Protection of Workers During Implementation

Alternative 1—No Action. Because Alternative 1 is the 'No Action' alternative, this criterion is not applicable.

Alternative 2—Removal of Surface and Geophysically Detected Subsurface MEC from Select Roadways and Beaches to Detection Depth. As with any MEC removal project, Alternative 2 does have worker safety issues to address prior to implementation. The main hazard to workers during implementation associated with this alternative is working with potentially live munitions. All personnel involved with the MEC removal will be qualified UXO technicians. All applicable safety requirements will be followed for handling, storage, and demolition/demilitarization. All exclusion areas where removal is taking place will be restricted access exclusion zones for explosive safety purposes. Only authorized personnel will be allowed in the exclusion zone. An additional hazard to workers during implementation is working in rough terrain in a tropical climate. Worker safety would be a concern for this alternative, but is a normal, manageable component of MEC removal activities. The above safety issues are shared with alternative 3. Safety concerns specific to alternative 2 consist of concerns specific to increased excavation and removal of MEC. Deeper excavations, if necessary, pose additional hazards, such as cave-ins, falling, and falling loads which may require additional safety measures to be implemented. While information is not available as to the depths and quantities of MEC in any area, as a general rule as the depth of excavation required increases, the risk for unintentional detonations during excavation also increases.

Alternative 3—Removal of Surface and Geophysically Detected Subsurface MEC from Select Roadways and Beaches to Anticipated Depth of Intrusive Activity. Worker safety issues with alternative 3 are the same as those for alternative 2 except without the hazards associated with deeper excavation.

Compliance with Chemical, Action and Location Specific ARARs

There are no chemical specific ARARs associated with this EE/CA. All action specific and location specific ARARs are summarized in Appendix A.

Short-term Effectiveness

Alternative 1—No Action. Alternative 1 does not provide any short term effectiveness at the former VNTR.

Alternative 2—Removal of Surface and Geophysically Detected Subsurface MEC from Select Roadways and Beaches to Detection Depth. Alternative 2 is effective in the short term by reducing the explosive safety risk of MEC and by providing LUCs/ICs to restrict intrusive activities at the site. Noise and potential explosive residue dust from munitions blown in place is a short term concern to the public. The notice protocol will be followed for detonating munitions found during MEC removal. Air monitoring is ongoing to address concerns about airborne explosive residues.

Alternative 3—Removal of Surface and Geophysically Detected Subsurface MEC from Select Roadways and Beaches to Anticipated Depth of Intrusive Activity. Alternative 3 has the same short term effectiveness as Alternative 2.

Long-term Effectiveness and Permanence

Alternative 1—No Action. Alternative 1 does not provide any long-term effectiveness.

Alternative 2—Removal of Surface and Geophysically Detected Subsurface MEC from Select Roadways and Beaches to Detection Depth. Alternative 2 is effective in the long-term by removing on-site MEC to detection depths. LUCs/ICs will be used to restrict access to only areas developed for public use and to restrict development of the site in the future without construction/avoidance support. Implementation of this alternative leaves the long-term possibility for circumstances to arise that could affect human health or the environment (e.g., erosion uncovering deeper MEC), but this is will likely occur over extended periods of time and LUCs/ICs will need to be implemented to increase the effectiveness of this alternative. Long term operation and maintenance would be required (e.g., signage) and periodic site evaluations would need to be performed to identify MEC that has migrated to the surface.

Alternative 3—Removal of Surface and Geophysically Detected Subsurface MEC from Select Roadways and Beaches to Anticipated Depth of Intrusive Activity. Alternative 3 is effective in the long-term because MEC is removed to clearance depths in proportion to the anticipated depth of intrusive activity associated with future land use plans and controlled activities within the site. However, because of the limits of current geophysical techniques to identify certain of the smaller MEC, the measures presented in Alternative 2 would also need to be implemented as part of this alternative: 1) signage and 2) periodic site evaluations to address MEC that has migrated to the surface.

4.3 Implementability

The *ease of implementation* of a technology refers to the availability of commercial services to support it, the constructability of the technology under specific site conditions, and the acceptability of the technology to all parties involved (regulators, public, owner, etc.), including technical feasibility, administrative feasibility, availability of services, support agency acceptance, and community acceptance. Levels of implementability were assessed based upon the number of "implementability criteria" satisfied by each alternative summarized in Table 4-3.

4.3.1 Alternative 1—No Action

Alternative 1 is the 'No Action' alternative; therefore, Implementability does not apply.

4.3.2 Alternative 2—Removal of Surface and Geophysically Detected Subsurface MEC from Select Roadways and Beaches to Detection Depth

Technical feasibility for alternative 2 is more difficult than alternative 3, with more extensive and deeper excavations. It is, however feasible within the following limits: the limit of the current geophysical technology to identify MEC at the depths discussed, and the limiting

depth of the water table for excavations on sandy beaches. Excavation in saturated beach sand requires sheet piling or some other form of excavation support. MEC safety considerations don't allow the advance driving of sheet piling without a MEC clearance of the proposed installation site. Excavations are therefore limited in depth to the top of the water table in beach sand areas. The limit of current geophysical technology to locate smaller targets such as some submunitions at depths less than 2 ft is one reason LUCs and ICs will be required. The LUCs/ICs may include deed notations, periodic visual evaluations, signage, restrictions on intrusive activities and potentially physical devices such as gates and/or fences to restrict entrance and/or usage of some areas (wilderness areas) within the former VNTR and SWMU 4. These physical controls would require regular monitoring to ensure their integrity and will in most cases be within the wildlife refuge restricted areas.

Administrative feasibility is not anticipated to be an issue. The permitting, LUCs and ICs are developed in agreement with federal and state regulators. Services and materials required for the remedy are available, and state and community acceptance of the remedy is anticipated.

Implementation of this alternative will likely result in deeper excavations possibly requiring remotely operated equipment and significantly more time, and a higher uncertainty as to scope and schedule.

4.3.3 Alternative 3—Removal of Surface and Geophysically Detected Subsurface MEC from Select Roadways and Beaches to Anticipated Depth of Intrusive Activity

Alternative 3 would be technically more feasible than Alternative 2 to implement. This is due to having a predetermined MEC removal depth. The chosen removal depth, based on the anticipated depth of intrusive activity at each site, will serve the proposed future land uses for the areas (which include ecological resource management and recreational use), result in less intrusive activities than alternative 2, and assumptions can be made with regards to logistics and scheduling based on the known level of effort to conduct excavations to a specific depth.

From a technical feasibility standpoint, Alternative 3 is more feasible than Alternative 2, with shallower excavations. The geophysical limits are the same as Alternative 2. It is anticipated that the water table will become the limiting factor on most excavations of significant depth on sandy beaches. The same LUCs and ICs will be required as for alternative 2, so administrative feasibility is expected to be the same. Services and materials for alternative 3 are available and state and community acceptance of the remedy is anticipated.

4.4 Cost

For the *detailed cost analysis* of alternatives, the expenditures required to complete each alternative were estimated in terms of capital costs, operation and maintenance (O&M) costs, long-term monitoring (LTM) costs, and indirect costs. Capital costs include costs to complete initial removal activities and dispose of all MEC and scrap metal resulting from

demolition/ demilitarization. O&M costs will be incurred to ensure the integrity of the LUCs and ICs for Alternative 2 and 3. Indirect costs include engineering expenses, license or permit costs, and contingency allowances. By combining the different costs associated with each alternative, a present-worth calculation for each alternative can be made for comparison.

The costs estimated for this section are provided to an accuracy of +50 percent and -30 percent. The alternative cost estimates are in 2006 dollars and are based on information published by R. S. Means *Site Work and Landscape Cost Data* and *Environmental Cost, Handling, Options and Solutions (ECHOS)*. Where R. S. Means data are not available or not applicable, quotes, previous costs, or engineering estimates are used for unit pricing. Appendix B contains the preliminary cost estimate for Alternatives 2 and 3. The assumptions for the site acreage and production rates are provided in Tables B-1 and B-2 of Appendix B.

4.4.1 Alternative 1—No Action

There are no costs associated with this alternative.

4.4.2 Alternative 2—Removal of Surface and Geophysically Detected Subsurface MEC from Select Roadways and Beaches to Detection Depth

The estimated total cost to this alternative is $24,851,599. Table B-1 in Appendix B contains a preliminary cost estimate for Alternative 2. Assumptions used for this cost estimate are:

- The entire removal action can be completed with one mobilization for UXO technicians and required equipment.
- Two teams will be working concurrently for the duration of the clearance effort.
- The work week will consist of five ten-hour days.
- Maximum depth of MEC removal is unknown due to the varying depths at which MEC items can be detected depending on their size and orientation. Removing MEC to detection depth adds a level of uncertainty due to the unknown depths that will be required to achieve this goal.

4.4.3 Alternative 3—Removal of Surface and Geophysically Detected Subsurface MEC from Select Roadways and Beaches to Anticipated Depth of Intrusive Activity

The estimated total cost to complete this alternative is estimated to be $19,311,906. Table B-2 in Appendix B contains a preliminary cost estimate for Alternative 3. Assumptions used for this cost estimate are:

- The entire removal action can be completed with one mobilization for UXO technicians and required equipment.
- Two teams will be working concurrently for the duration of the clearance effort.
- The work week will consist of five 10-hour days.

- The maximum depth of MEC removal will vary depending on anticipated land use for each area beaches.
- Based on the assumptions for clearance depth given in Appendix B, Table B-2, an estimated increase in production of 1 acre per week relative to Alternative 2 results in the lower cost shown above.

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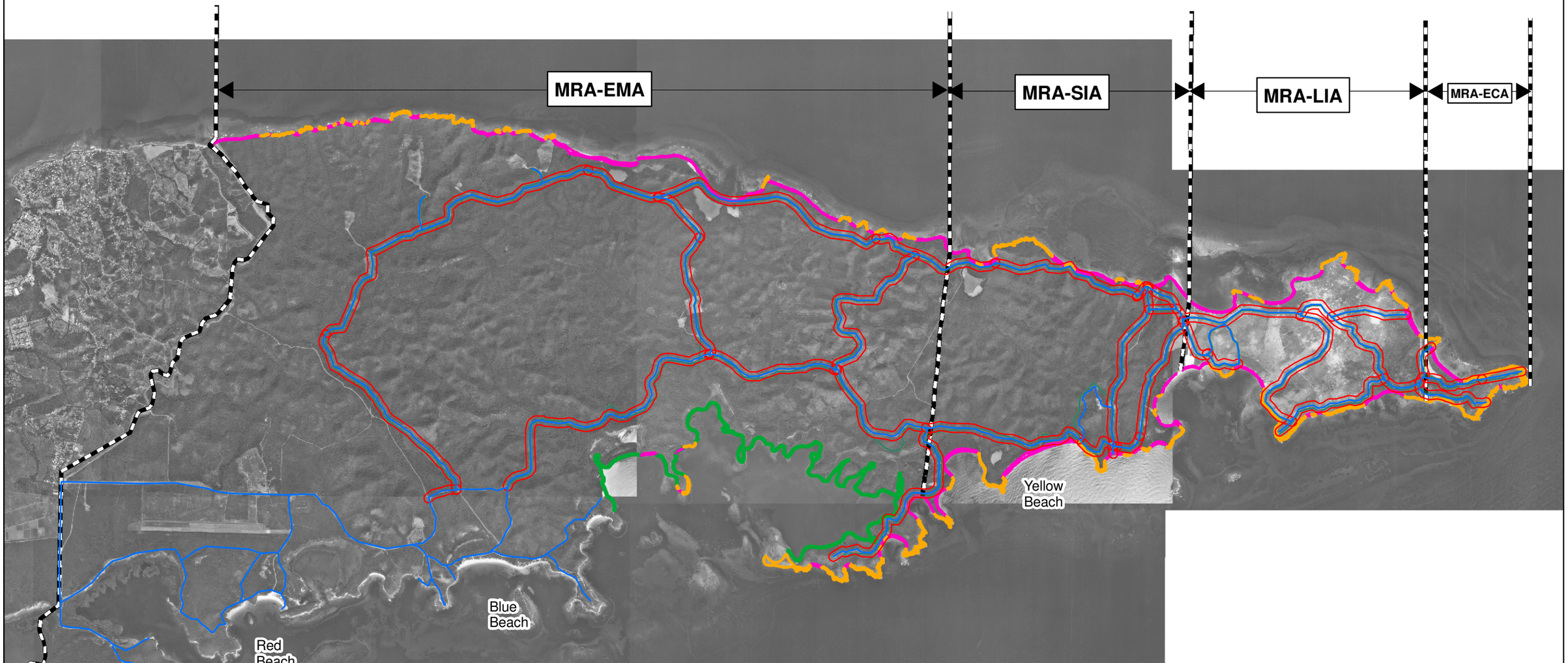

Legend
- MRA Boundaries
- Edge of Wetland
- Road and 50 ft Buffer Removal Areas
- Rocky Beach Removal Area
- Sandy Beach Removal Area

Note: Road buffers not to scale

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Figure 4-1
Areas of MEC Removal Along the Former VNTR
Roadways (with buffers) and Beaches
Former VNTR, Vieques, Puerto Rico

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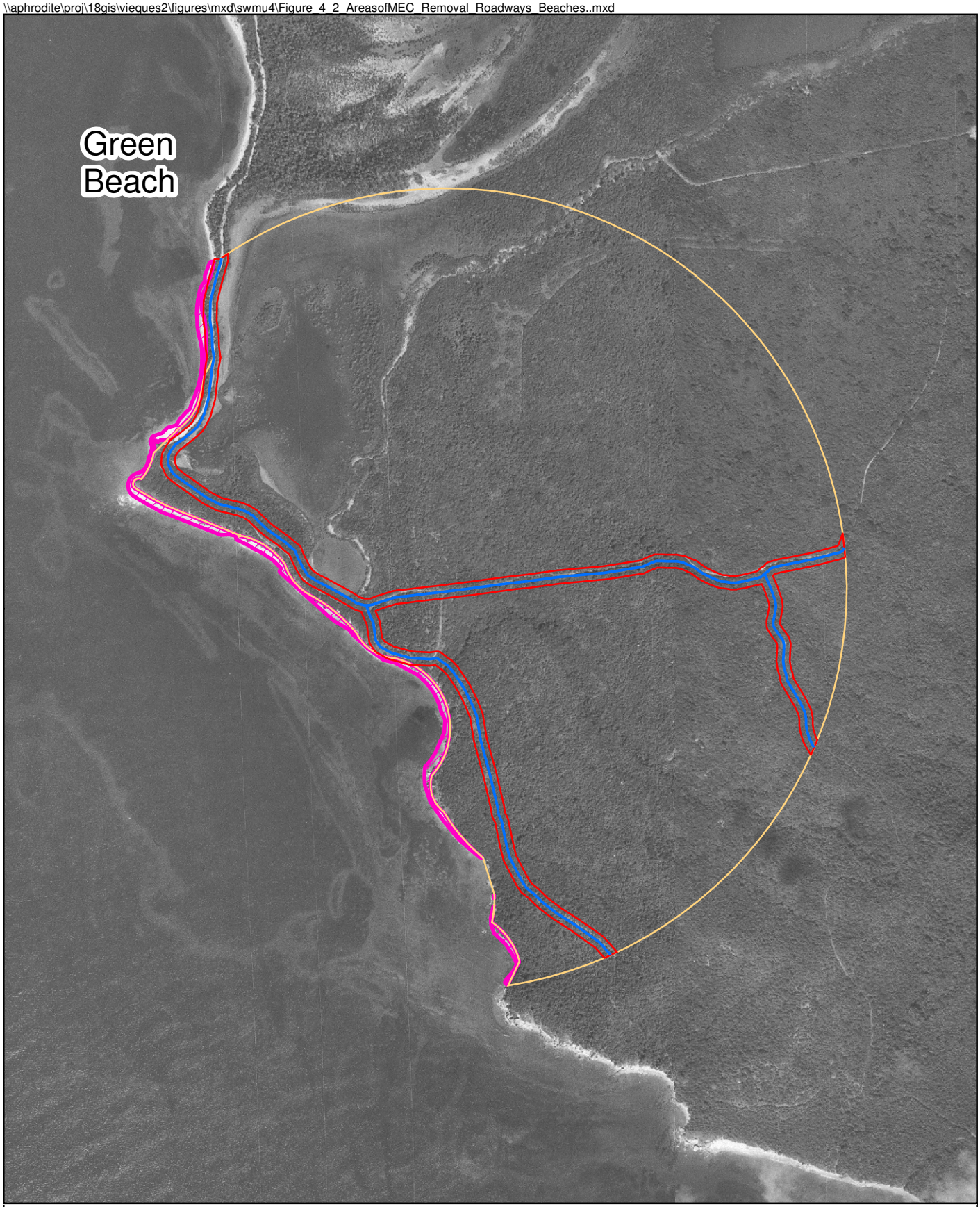

Legend

- Roads and 50 ft Buffer Removal Areas
- SWMU 4 Boundary
- Sandy Beach Areas

N
W E
S

0 500 1,000 2,000
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Figure 4-2
MEC Removal Areas at SWMU-4
Roadways (with Buffers) and Beaches
Vieques, Puerto Rico

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SECTION 5

Comparative Analysis of Removal Action Alternatives

This section provides an evaluation of the removal action alternatives in accordance with the USEPA guidance document *Guidance on Conducting Non-Time Critical Removal Actions Under CERCLA* (USEPA/540-R-93-057). The removal action alternatives are evaluated in terms of effectiveness, implementability, and cost. A summary of the comparative analysis is provided in Table 5-1.

5.1 Effectiveness

The overall effectiveness of Alternative 1 is low. The effectiveness of Alternatives 2 and 3 is high. These levels of effectiveness were assessed based on the number of "effectiveness criteria" that would be satisfied by each alternative. The "effectiveness criteria," from the USEPA guidance are identified as:

1. Protection of public health
2. Protection of workers during implementation
3. Protection of environment
4. Compliance with ARARs
5. Level of treatment and containment expected
6. Residual effect concerns

Alternative 1 does not achieve the RAOs. Alternatives 2 and 3 have been developed because they were able to achieve all the identified RAOs discussed in Section 3. If the RAO is achieved, then public health is protected.

Workers can be protected during implementation of both Alternatives 2 and 3 using standard personal protective equipment and MEC detecting devices and procedures. The explosive safety risk to the public is significantly reduced through the removal of MEC contamination, which, if left in place, could also potentially serve as a source of chemical environmental contaminants. Alternative 2 is potentially more protective of the public health and safety than Alternative 3 because it has the potential to remove more MEC.

Both alternatives can comply with the location-specific and action-specific ARARs, which apply to the implementation of the alternatives. The removal action will adhere to all regulations regarding environmentally sensitive locations, excavations, detonations, and explosives transportation, use, and storage.

The level of MEC clearance varies among all three alternatives, with Alternative 2 being the most complete solution. However, based on the proposed future land use, Alternative 3 will also provide an adequate level of protection. Both Alternatives 2 and 3 will require LUCs/ICs, so no substantial benefit with regards to future controls would be realized from either Alternative.

5.2 Implementability

The implementability evaluation of the alternatives varies from easy to difficult. These levels of implementability were assessed based on the number of "implementability criteria" satisfied by each alternative. The "implementability criteria," from the USEPA guidance document *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA* (USEPA/540-R-93-057), are as follows:

1. Construction and operational considerations
2. Demonstrated performance/useful life
3. Adaptable to environment conditions
4. Contributes to remedial performance
5. Can be completed in an acceptable timeframe.
6. Availability of equipment, personnel, and services, outside laboratory testing capacity, and offsite treatment and disposal capacity
7. Permits required
8. Easements or rights-of-way required
9. Impact on adjoining property
10. Ability to impose institutional controls

Evaluation of implementability is essentially the evaluation of technical and administrative feasibility. The technical feasibility consists of items 1 through 6 above, and administrative feasibility involves items 7 through 10.

All of the alternatives are technically feasible. MEC contamination will remain onsite under Alternative 1 as no efforts will be expended to remove it. Implementation of the surface and subsurface clearance under Alternative 2 and 3 is technically feasible with the exception of excavations on the beach below the water table or through bedrock. The subsurface clearance below the water table on beaches may not be technically feasible because of the need for some sort of sheet piling coffer dam to keep the excavation from collapsing, and the need to be able to dig in advance of the driving of the coffer dam to confirm safety to drive it into the ground. Excavations on the beach will not be able to go much below the water table. Alternative 3 is more administratively feasible because known depths of removal are being used vice the unknown depths for Alternative 2.

5.3 Cost

The present-worth costs (relative scaling) of each of the alternatives are summarized in Table 5-1. The cost breakdown for each alternative is provided in Appendix B. Although Alternative 2 is the most costly and the most complete solution, Alternative 3 is the most cost effective. Through tailoring the clean up to mirror the desired land use, the efforts expended to complete Alternative 3 will satisfy the RAO in the shortest time frame and therefore at the lower cost.

TABLE 5-1
Relative Remedial Alternative Comparison

Alternative	Effectiveness	Implementation	Cost
THE FORMER VNTR			
Alternative 1—No Action	Not Effective	Easy	No cost
Alternative 2— Removal of Surface and Geophysically Detected Subsurface MEC from Select Roadways and Beaches to Detection Depth	Effective	Most Difficult	Greatest Cost
Alternative 3— Removal of Surface and Geophysically Detected MEC from Select Roadways and Beaches to Anticipated Depth of Intrusive Activity	Effective	Moderate	Moderate

Notes:
MEC = munitions and explosives of concern, VNTR = Vieques Naval Training Range

SECTION 6

Recommended Removal Action Alternative

The EE/CA was performed in accordance with current USEPA and Navy guidance documents for a NTCRA under CERCLA. Three alternatives were analyzed based on evaluation of the effectiveness, implementability, and cost. The effectiveness evaluation included reviewing the protectiveness of the alternative and its ability to meet the RAOs. Implementability included looking at the technical feasibility, availability, and administrative feasibility of the alternative. The evaluation of cost included a review of capital cost, operating cost, and present-worth cost.

Alternative 3, – Removal of Surface and Geophysically Detected Subsurface MEC from Select Roadways and Beaches to Anticipated Depth of Intrusive Activity, is the recommended alternative. Alternative 3 is recommended because it will achieve the remedial action objectives for the roadways and beaches of the former VNTR and SWMU 4 with a high certainty of success. Based on land use, and the limits of current technology, risks will be significantly reduced but not eliminated. Risks from MEC cannot be completely eliminated at any site because of the limits of current geophysical technology to detect MEC. Land use controls provide additional protection. This alternative would minimize the explosive safety risk to the public and USFWS workers for the identified land uses. Periodic site reviews (e.g., 5-Year Reviews) and maintenance will provide a method for monitoring the migration of subsurface material to the surface. Implementation of Alternative 3 is technically feasible and, under the current projected land use, provides a permanent remedy (including future LUCs/ICs). The cost for implementation of Alternative 3 is estimated to have a present worth of $19,311,906.

SECTION 7

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Appendix A
Applicable or Relevant and Appropriate Requirements

Contents

Tables

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Table A-1
Federal Location-Specific ARARs
For the Former VNTR and SWMU 4 at the former NASD, Vieques, Puerto Rico

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Protection of Floodplain*					
Within floodplain	Actions taken should avoid adverse effects, minimize potential harm, restore and preserve natural and beneficial values.	Action that will occur in a floodplain (i.e., lowlands and relatively flat areas adjoining inland and coastal waters and other flood-prone areas).	40 CFR Part 6, Appendix A; excluding Sections 6(a)(2), 6(a)(4), 6(a)(6); 40 CFR 6.302	Applicable	Removal activities may require compliance with this order. Measures required may include erosion control.
Protection of Wetlands*					
Wetland	Action to minimize the destruction, loss, or degradation of wetlands.	Wetland as defined by Executive Order 11990 Section 7.	40 CFR 6, Appendix A; excluding Sections 6(a)(2), 6(a)(4), 6(a)(6); 40 CFR 6.302	Relevant and Appropriate	Federal or Puerto Rico regulated wetlands are present. Nationwide Permit No. 38 allows for activities in wetlands to contain, stabilize, or remove hazardous or toxic materials. "Notification" is required to the District Engineer and the wetlands on the site should be delineated. Activities undertaken entirely on a CERCLA site by authority of CERCLA, as approved or required by EPA, are not required to obtain permits under Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act, although the substantive requirements of these permits shall be met. NWP 38 notification will put in place coordination with natural resource and historic resource trustees regarding the potential to adversely affect threatened and endangered species and sites protected under the National Historic Preservation Act.

Table A-1
Federal Location-Specific ARARs
For the Former VNTR and SWMU 4 at the former NASD, Vieques, Puerto Rico

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Clean Water Act, Section 404*a					
Wetland	Action to prohibit discharge of dredged or fill material into wetland without permit.	Wetland as defined by Executive Order 11990 Section 7.	40 CFR 230.10; 40 CFR 231 (231.1, 231.2, 231.7, 231.8)	Relevant and Appropriate	Non-time critical removal action may include removal and restoration of wetland sediments. Activities undertaken entirely on a CERCLA site by authority of CERCLA, as approved or required by EPA, are not required to obtain permits under Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act, although the substantive requirements of these permits shall be met.
Endangered Species Act of 1978*					
Endanger-ed species	Action to ensure that any action is not likely to jeopardize the continued existence of endangered or threatened species or adversely affect its critical habitat.	Applies to actions that affect endangered or threatened species or their habitat.	16 USC 1531 50 CFR Part 402	Relevant and Appropriate	Multiple federally listed or proposed endangered species are known to exist at SWMU 4 and on the former VNTR. A Consultation with US Fish and Wildlife Service as necessary will be completed under this ARAR.
Federal Fish and Wildlife Conservation Act					
Fish and Wildlife	Requires that activities avoid, minimize, or compensate for impacts to fish and wildlife and their habitats.	Applies to actions that affect fish and wildlife and their habitat.	16 USC §662 et seq.	Relevant and Appropriate	Site Restoration at the former VNTR and SWMU 4, including the tidally influenced lagoon, will provide enhanced habitat for fish and wildlife species.

Table A-1
Federal Location-Specific ARARs
For the Former VNTR and SWMU 4 at the former NASD, Vieques, Puerto Rico

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Coastal Zone and Management Act					
Coastal Zone	Requires that activities conducted within a coastal zone be consistent with an approved state management program.	Applies to sites located within a coastal zone.	16 USC §1451 et seq.	Relevant and Appropriate	Parts of the former VNTR and SWMU 4 and surrounding vicinity are located within the coastal zone. Activities will be conducted in accordance with applicable management program(s).
National Historical Preservation Act (NHPA) of 1966 and Archaeological Resources Protection Act of 1979					
Historical Locations and Archaeolo-gical Artifacts	Provides for the recovery and preservation of historical and archaeological significant artifacts. Implementing regulations for NHPA (36 CFR Part 65) establish the National Register of Historic Places and provide for preservation of historic properties and minimization of damage to historic landmarks.	Applies to historical properties and landmarks, and archaeological artifacts.	NHPA: 16 USC §470; 36 CFR Part 65. Archaeological Resources Protection Act.	Relevant and Appropriate	Based upon historical site use and filling activities that were conducted in the vicinity, it is not likely that historical landmarks or artifacts exist at SWMU 4 and surrounding vicinity.

* Statutes and policies, and their citations are provided as headings to identify general categories of potential ARARs for the convenience of the reader. Listing the statutes and policies does not indicate that Navy accepts the entire statues or policies as potential ARARs. Specific potential ARARs are addressed in the table below each general heading; only substantive requirements of the specific citations are considered potential ARARs.

ARARs - Applicable or relevant and appropriate requirements

CFR - Code of Federal Regulations

NWP - Nationwide Permit

USC - United States Code

Table A-2
Puerto Rico Location-Specific ARARs
For the Former VNTR and SWMU 4 at the former NASD, Vieques, Puerto Rico

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Puerto Rico Water Control Laws and Puerto Rico Wetlands Regulations*					
Coastal Zone Management Act; NOAA Regulations of Federal Consistency with approved State Coastal Zone Management Programs (Natural Patrimony Program Law of Puerto Rico)					
Within coastal zone	Conduct activities within a coastal Management Zone in a manner consistent with local requirements.	Activities conducted at Natural Reserves and Special Areas of Planification	Section 307(c) of 16 USC 1456(c); also see 15 CFR 930 and 923.45	Relevant and Appropriate	SWMU 4 is located in the Coastal Zone, but is not located in areas classified as Natural Reserves or Special Areas of Planification.

* Statutes and policies, and their citations, are provided as headings to identify general categories of potential ARARs for the convenience of the reader. Listing the statutes and policies does not indicate that Navy accepts the entire statutes or policies as potential ARARs. Specific potential ARARs are addressed in the table below each general heading; only substantive requirements of the specific citations are considered potential ARARs.

ARARs - Applicable or relevant and appropriate requirements

CFR - Code of Federal Regulations

CWA - Clean Water Act

NOAA - National Oceanic and Atmospheric Administration

TBC - To Be Considered

USACE - United States Army Corps of Engineers

VAC - Virginia Administrative Code

VDEQ - Virginia Department of Environmental Quality

Table A-3
Puerto Rico Action-Specific ARARs
For the Former VNTR and SWMU 4 at the former NASD, Vieques, Puerto Rico

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Puerto Rico Environmental Impact Statement Regulations*					
Environmental Impact Statements	Regulations to establish content requirements and administrative procedures for complying with the Environmental Impact Statement (EIS) procedure required by the Environmental Public Policy A	Determination of whether or not actions will have a significant environmental impact in the normal course of their activities	Regulation on Puerto Rico Environmental Impact Statement	Not Applicable	Proposed removal actions do not trigger the requirement to perform an Environmental Impact Statement at SWMU 4 or the former VNTR.
Puerto Rico Control of Noise					
Noise Control Requirements	These regulations define requirements for the management and control of noise pollution.	Applicable to any activity which may include site preparation, demolition, removal, or disposal, excavation, occurring on premises, right-of-ways, public or private structures or similar property.	Regulation for the Control of Noise Pollution, Puerto Rico Regulation 3418	Applicable	Applicable to management of noise during MEC removal, detonation/demilitarization, and site restoration activities at SWMU 4 and the former VNTR.

Table A-3
Puerto Rico Action-Specific ARARs
For the Former VNTR and SWMU 4 at the former NASD, Vieques, Puerto Rico

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Puerto Rico Hazardous Waste and Non-Hazardous Solid Waste Regulations					
Hazardous Waste Staging Transport, and Disposal	These regulations and laws define the requirements for the management of hazardous wastes.	Wastes must meet definition of hazardous waste.	Regulation for the Control of Hazardous and Non-Hazardous Solid Waste, Puerto Rico Regulation 2863.	Relevant and Appropriate	Scrap metal and waste excavated during the MEC removal action at SWMU 4 and the former VNTR will be characterized for disposal. Existing data indicate waste will be non-hazardous; however, any identified hazardous waste will be managed accordingly.
Solid Waste Staging Transport, and Disposal	These regulations and laws define the requirements for the management of solid wastes, including the submittal of a Non-Hazardous Solid Waste Operating Plan. Any disposal facility must be properly permitted and in compliance with all operational and monitoring requirements of the permit and regulations.	Wastes must meet definition of solid waste.	Regulation for the Control of Hazardous and Non-Hazardous Solid Waste, Puerto Rico Regulation 2863	Applicable	Applicable to management and staging, transportation, and off-site disposal of any debris classified as a solid waste at SWMU 4 and the former VNTR.
Puerto Rico Solid Waste Management Regulations					
Solid Waste Staging Transport, and Disposal	These regulations and laws define the requirements for the management of solid wastes. Any disposal facility must be properly permitted and in compliance with all operational and monitoring requirements of the permit and regulations.	Wastes must meet definition of solid waste.	Regulation for the Management of Non-Hazardous Solid Waste, Puerto Rico Regulation 5717	Applicable	Applicable to management and staging, transportation, and off-site disposal of any debris classified as a solid waste.

Table A-3
Puerto Rico Action-Specific ARARs
For the Former VNTR and SWMU 4 at the former NASD, Vieques, Puerto Rico

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Puerto Rico Air Pollution Control Regulations*					
Discharge to air	Puerto Rico Ambient Air Quality Standards - standards for ambient air quality to protect public health and welfare (including standards for particulate matter and lead).	Contamination of air affecting public health and welfare.	Regulation For The Control Of Atmospheric Pollution Of The Commonwealth Of Puerto Rico., Puerto Rico Regulation 5300	Applicable	Applicable for all site removal activities that may generate air discharges. No discharges to air are anticipated other than fugitive dust.
Discharge of visible emissions and fugitive dust	Fugitive dust/emissions may not be discharged to the atmosphere at amounts in excess of standards.	Any source of fugitive dust/ emissions.	Regulation For The Control Of Atmospheric Pollution Of The Commonwealth Of Puerto Rico., Puerto Rico Regulation 5300	Applicable	Applicable for any site removal activities that generate fugitive dust.
Discharge of toxic pollutants	Toxic pollutants may not be discharged to the atmosphere at amounts in excess of standards.	Any source of toxic pollutants	Regulation For The Control Of Atmospheric Pollution Of The Commonwealth Of Puerto Rico., Puerto Rico Regulation 5300	Not Applicable	No toxic air pollutants are anticipated as part of this NTCRA.

Table A-3
Puerto Rico Action-Specific ARARs
For the Former VNTR and SWMU 4 at the former NASD, Vieques, Puerto Rico

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Puerto Rico Regulation for the Control of Erosion and Prevention of Sedimentation					
Erosion / Sediment Control	Regulates erosion / sedimentation control practices and management, including a Control of Erosion and Sediment (CES) Plan and a CES Permit.	Land disturbing activities.	Regulation for the Control of Erosion and Prevention of Sedimentation, Puerto Rico Regulation 5754	Applicable	Applicable for any site removal activities resulting in possible erosion and sedimentation. The NTCRA will include meeting the substantive requirements for erosion and sediment control including a CES Plan and CES Permit.
Explosives	Law of Explosives of Puerto Rico		28 June 1969, Law Number 134	Applicable	

* Statutes and policies, and their citations, are provided as headings to identify general categories of potential ARARs. Specific ARARs are addressed in the table below each general heading.

ARAR - Applicable or relevant and appropriate requirement

CFR - Code of Federal Regulations

NTCRA - Non-time critical removal action

TBC - To Be Considered

Table A-4
Federal Action-Specific ARARs
For the Former VNTR and SWMU 4 at the former NASD, Vieques, Puerto Rico

Requirement	Prerequisite	Citation	ARAR Determination	Comment
Explosives and Blasting Agents; Welding and Cutting Activities	Occupational Safety and Health Administration	29 CFR Part 1910 §H.109, and §Q.	Relevant and Appropriate	
Occupational Safety and Health Administration - General Construction Work	Construction work.	29 CFR Part 1926	Applicable	Construction work at SWMU 4 and the former VNTR will adhere to these regulations.
EPA Final Military Munitions Rule	Remedial actions generate munitions that are subject to RCRA requirements.	40 CFR 260, et al.	Applicable	The remedial actions for SWMU 4and the former VNTR will likely generate military munitions waste which may be classified as hazardous.
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980	NCP and Hazardous Waste Handling; Military Munitions	40 CFR Parts 266, 300, 370.	Relevant and Appropriate	
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980	EPA Guidance	42 U.S.C. Section 9601	Applicable	
Superfund Amendments and Reauthorization Act (SARA) of 1986	EPA Guidance	42 U.S.C. Section 11001	Applicable	
Handbook on Management of Unexploded Ordnance at Closed, Transferring, and Transferred Ranges	EPA Guidance	March 2000 (Draft)	Applicable	
Resource Conservation and Recovery Act	EPA Guidance	42 U.S.C. Section 6901	Not Applicable	

Table A-4
Federal Action-Specific ARARs
For the Former VNTR and SWMU 4 at the former NASD, Vieques, Puerto Rico

Requirement	Prerequisite	Citation	ARAR Determination	Comment
Hazardous Waste Regulations*	EPA Guidance	Title 126	Applicable	
Emergency Planning & Community Right-to-Know and Contingency Planning Regulations (Reporting Requirements)	EPA Guidance	Title 126		
UXO Technicians and Personnel	Minimum qualifications	DDESB Technical Paper 1	Relevant and Appropriate	
DoD Contractors Safety Manual for Ammunition and Explosives	Department of Defense Guidance	DOD 4145.26M	Applicable	
Defense Demilitarization Manual	Department of Defense Guidance	DOD 4160.21-M-1	Relevant and Appropriate	Neither SWMU 4 nor the former VNTR are located at a DOD Component. Demilitarization of live ordnance will follow the instructions provided.
Environmental and Explosives Safety Management on Department of Defense Active and Inactive Ranges Within the United States	Department of Defense Guidance	DOD 4715.11	Applicable	
Ammunition and Explosives Safety Standards	Action involves a transfer of DOD lands.	DOD 6055.9-STD	Relevant and Appropriate	Remedial actions for SWMU 4 and the former VNTR include a transfer of DOD lands.
Safety and Occupational Health Policy for the Department of Defense	Actions taking place on DOD lands.	DOD Directive 1000.3	Relevant and Appropriate	Remedial actions for SWMU 4 and the former VNTR will adhere to these regulations.
Solid Waste Management – Collection, Disposal, Resource Recovery, and Recycling Program	Actions taking place on DOD lands which include the generation of solid waste.	DOD Directive 4165.6	Relevant and Appropriate	Remedial actions for SWMU 4 and the former VNTR will adhere to these regulations.

Table A-4
Federal Action-Specific ARARs
For the Former VNTR and SWMU 4 at the former NASD, Vieques, Puerto Rico

Requirement	Prerequisite	Citation	ARAR Determination	Comment
Transportation and Traffic Management	Actions taking place on DOD lands which create a significant traffic flow.	DOD Directive 4500.9	Relevant and Appropriate	Remedial actions for the former VNTR and SWMU 4 will adhere to these regulations during construction.
Natural Resource Management Plan	Actions taking place on DOD lands.	DOD Directive 4700.4	Relevant and Appropriate	Remedial actions for the former VNTR and SWMU 4 will adhere to these regulations
Archaeological and Historical Resources Management Plan	Actions taking place on DOD lands.	DOD Directive 4710.1	Applicable	An evaluation of SWMU 4 and the former VNTR will be conducted as necessary to determine any archeological or historical resources
Protection and Enhancement of Environmental Quality	Actions taking place on DOD lands.	DOD Directive 5100.5	Relevant and Appropriate	Remedial actions for SWMU 4 and the former VNTR will adhere to these regulations
Environmental Effects in the United States of DOD Actions	Actions taking place on DOD lands.	DOD Directive 6050.1	Relevant and Appropriate	Remedial actions for SWMU 4 and the former VNTR will adhere to these regulations
Safety and Health Requirements for Hazardous, Toxic, and Radioactive Waste and Ordnance and Explosive Waste Activities	Actions which include a HTRW or OE site.	ER 385-1-92	Relevant and Appropriate	Neither SWMU 4 nor the former VNTR are located on a USACE Command, but the requirements in this regulation for OE safety are relevant to these sites.
Military munitions response program oversight	Department of Defense Guidance	NOSSA 8020.15	Applicable	
Inter-service Responsibilities for Explosive Ordnance Disposal	US Navy and Department of the Army guidance	OPNAVINST 8027.1 AR 75-14	Applicable	
Interim Final Management Principles for Implementing Response Action at Closed, Transferring, and Transferred Ranges	OE Guidance Memoranda	December 19, 2000	Applicable	

Table A-4
Federal Action-Specific ARARs
For the Former VNTR and SWMU 4 at the former NASD, Vieques, Puerto Rico

Requirement	Prerequisite	Citation	ARAR Determination	Comment
Application of the Hazardous Waste Operations and Emergency Response Regulation to Ordnance and Explosives Sites	OE Guidance Memoranda	January 20, 1994	Applicable	
Coordination with the Ordnance and Explosives Center of Expertise (OE CX)	OE Guidance Memoranda	May 7, 1997	Applicable	
Ammunition and Explosives Ashore: Safety Regulations for Handling, Storing, Production, Renovation, and Shipping	US Navy Guidance	NAVSEA OP 5 Vol 1	Applicable	
Navy Transportation Safety Handbook for Ammunition, Explosives, and Related Hazardous Materials	US Navy Guidance	NAVSEA OP 2165	Applicable	
Motor Vehicle Driver's Handbook, Ammunition, Explosives, and Related Hazardous Materials	US Navy Guidance	NAVSEA OP 2239	Applicable	
Demilitarization and Disposal of Excess, Surplus, and Foreign Excess Ammunition, Explosives and Other Dangerous Articles and Inert Ordnance Material	US Navy Guidance	NAVSEA 4570.1	Applicable	
DOD Ammunition and Explosives Hazard Classification Procedures Joint Technical Bulletin	US Navy Guidance	NAVSEAINST 8020.1H	Applicable	
Operational Risk Management (ORM)	US Navy Guidance	OPNAVINST 3500.39A	Applicable	

Table A-4
Federal Action-Specific ARARs
For the Former VNTR and SWMU 4 at the former NASD, Vieques, Puerto Rico

Requirement	Prerequisite	Citation	ARAR Determination	Comment
Department of the Navy Explosives Safety Policy	US Navy Guidance	OPNAVINST 8020.14	Applicable	
U.S. Navy Explosives Safety Policies, Requirements, and Procedures	US Navy Guidance	OPNAVINST 8023.2	Applicable	
Navy Munitions Disposition Policy	US Navy Guidance	OPNAVINST 8026.2A	Applicable	
Responsibilities for Technical Escort of Dangerous Materials	US Navy Guidance	OPNAVINST 8070.1B	Applicable	
Responsibilities for Issuance and Administration of Waivers and Exemptions from Department of Defense Explosive Safety Standards	US Navy Guidance	SECNAVINST 8023.3C	Applicable	

Appendix B
Detailed Cost Estimates

Table B-1
Detailed Cost Estimate
Alternative 2 Removal to Depth of Detection
Former VNTR Roadways and Beaches EE/CA
Vieques, Puerto Rico

Item	Quantity	Units	Unit Cost	Adjustment*	Subtotal
2 EXPENSES AND CONSUMABLES					
2.1 Per diem -M&I meals (assuming 10 person team with 2 being local)	1238	day	$57.00	8	$564,528
2.2 Per diem - lodging	1238	day	$60.00	8	$594,240
2.3 Transportation	1238	day	$60.00	4	$297,120
2.4 Schondstet/All metals detectors	6	each	$1,100.00	1	$6,600
2.5 GPS/RTK	177	wk	$80.00	1	$14,160
2.6 Daily Consumables	805	day	$15.00	1	$12,075
2.7 Health and Safety Consumables	805	day	$20.00	1	$16,100
2.8 EM 61	177	wk	$380.00	3	$201,780
2.9 Backhoe/Bobcat	42	mo	$2,000.00	2	$168,000
3 MOBILIZATION/DEMOBILIZATION AND SITE SETUP					
3.1 Mobilization	1	ea	$65,000.00	1	$65,000
3.2 Demobilization	1	ea	$45,000.00	1	$45,000
3.3 Road Repair	1	ls	$7,500.00	1	$7,500
3.4 Establish Grids	1	ls	$20,000.00	1	$20,000
3.5 Geophysical Mapping	318	ac	$4,000.00	1	$1,272,000
3.6 Flora and Avian Habitat Survey	244	ac	$400.00	0.4	$39,040
3.7 Turtle Nesting Survey	74	ac	$1,000.00	1	$74,000
4 REACQUISITION/QA					
4.1 Reaquisition and Quality Assurance	805	day	$2,742.00	1	$2,207,310
5 MEC/MPPEH CLEARANCE					
5.1 MEC Surface Removal (up to 100 items per acre)	385	ac	$2,500.00	1	$962,500
5.2 Roadway MEC Subsurface Removal (assume: maximum removal depth of 6 feet, engineering controls, decreased production rate of 1 acre per week relative to Alternative 3)	244	ac	$16,932.00	1	$4,131,408
5.3 Beach MEC Subsurface Clearance (assume: maximum removal depth of 6 feet, engineering controls, no dewatering, decreased production rate of 1 acre per week relative to Alternative 3)	74	ac	$16,932.00	1	$1,252,968
5.4 MPPEH Surface Removal (up to 100 items per acre)	385	ac	$4,000.00	1	$1,540,000
4.5 Roadway Buffer Vegetation Clearance with Mechanical Means	244	ac	$2,000.00	1	$488,000
5.6 Roadway Buffer Vegetation Clearance Avoidance Support	244	ac	$1,500.00	1	$366,000
6 DEMILITARIZATION OF MEC ITEMS					
6.1 Demolition/Explosive venting	87	event	$6,773.00	1	$589,251
7 POST REMOVAL					
7.1 Establish and Implement Land Use Control Plan to Restrict Future Development	1	ls	$10,000.00	1	$10,000
7.2 Signage for Restricting Access, Potential Beach Landings	25	ea	$150.00	1	$3,750
Subtotal					**$14,948,330**
Project Management	8%				$1,195,866
Remedial Design	15%				$2,242,250
Construction Management	10%				$1,494,833
Contingency	25%				$4,970,320
TOTAL COST					**$24,851,599**
Upper Limit of Cost Accuracy	150%				**$37,277,398**
Lower Limit of Cost Accuracy	70%				**$17,396,119**

*Adjustment is for the number of personnel/items required for site work

5.2 - Assume: maximum removal depth of 6 ft for 15% of anomalies, engineering controls will be used for excavations, which will reduce production rate by 1 acre/week relative to Alternative 3.

5.3 - Assume: maximum removal depth of 6 ft for 15% of anomalies, engineering controls will be used for excavations, no dewatering will be performed, which will reduce production rate by 1 acre/week relative to Alternative 3.

Table B-2
Detailed Cost Estimate
Alternative 3 Removal to Anticipated Depth of Intrusive Activity
Former VNTR Roadways and Beaches EE/CA
Vieques, Puerto Rico

Item	Quantity	Units	Unit Cost	Adjustment*	Subtotal
2 EXPENSES AND CONSUMABLES					
2.1 Per diem - M & I (assuming 10 person team with 2 being local)	828	day	$57.00	8	$377,568
2.2 Per diem - lodging	828	day	$60.00	8	$397,440
2.3 Transportation	828	day	$60.00	4	$198,720
2.4 Schondstet/All metals Detectors	6	each	$1,100.00	1	$6,600
2.5 GPS/RTK	119	wk	$80.00	1	$9,520
2.6 Daily Consumables	536	day	$15.00	1	$8,040
2.7 Health and Safety Consumables	536	day	$20.00	1	$10,720
2.8 EM-61	119	wk	$380.00	3	$135,660
2.9 Backhoe/Bobcat	30	mo	$2,000.00	2	$120,000
3 MOBILIZATION/DEMOBILIZATION AND SITE SETUP					
3.1 Mobilization	1	ea	$65,000.00	1	$65,000
3.2 Demobilization	1	ea	$45,000.00	1	$45,000
3.3 Road Repair	1	ls	$7,500.00	1	$7,500
3.4 Establish Grids	1	ls	$20,000.00	1	$20,000
3.5 Geophysical Mapping	318	ac	$4,000.00	1	$1,272,000
3.6 Flora and Avian Habitat Survey	244	ac	$400.00	0.4	$39,040
3.7 Turtle Nesting Survey	74	ac	$1,000.00	1	$74,000
4. REAQUISITION					
4.1 Reaquisition and Quality Assurance	536	day	$2,742.00	1	$1,469,712
5. MEC/MPPEH CLEARANCE					
5.1 MEC Surface Removal (up to 100 items per acre)	385	ac	$2,500.00	1	$962,500
5.2 Roadway MEC Subsurface Removal (assume standard 2 ft depth, no engineering controls)	244	ac	$11,310.00	1	$2,759,640
5.3 Beach MEC Subsurface Removal (assume maximum 4 ft depth, no engineering controls or dewatering)	74	ac	$11,310.00	1	$836,940
5.4 MPPEH Surface Removal (up to 100 items per acre)	385	ac	$4,000.00	1	$1,540,000
5.5 Roadway Buffer Vegetation Clearance with Mechanical Means	244	ac	$2,000.00	1	$488,000
5.6 Roadway Buffer Vegetation Clearance Avoidance Support	244	ac	$1,500.00	1	$366,000
6 DEMILITARIZATION OF MEC ITEMS		event			
6.1 Demolition/Explosive Venting	58	event	$6,773.00	1	$392,834
7 POST REMOVAL					
6.1 Establish and Implement Land Use Control Plan to Restrict Future Development	1	ls	$10,000.00	1	$10,000
6.2 Signage for Restricting Access, Potential Beach Landings	25	ea	$150.00	1	$3,750
Subtotal					**$11,616,184**
Project Management	8%				$929,295
Remedial Design	15%				$1,742,428
Construction Management	10%				$1,161,618
Contingency	25%				$3,862,381
TOTAL COST					**$19,311,906**
Upper Limit of Cost Accuracy	150%				**$28,967,859**
Lower Limit of Cost Accuracy	70%				**$13,518,334**

*Adjustment is for the number of personnel/items required for site work

5.2 - Assume: 2 ft maximum clearance depth with no engineering controls.
5.3 - Assume: 4 ft maximum clearance depth with no engineering controls.

Appendix C
Responses to Comments

Response to Comments on *Draft EE/CA for MEC Removal from the Beaches and Roadways of SWMU 4, Former NASD and Munitions Response Area: Eastern Maneuver Area, Surface Impact Area, Live Impact Area, and Eastern Conservation Area, Former VNTR, Vieques, Puerto Rico*

Below are the responses to comments (RTCs) received on the *Draft EE/CA for MEC Removal from the Beaches and Roadways of SWMU 4, Former NASD and Munitions Response Area: Eastern Maneuver Area, Surface Impact Area, Live Impact Area, and Eastern Conservation Area, Former VNTR, Vieques, Puerto Rico*. Comments are presented as received, shown in italics, followed by Navy responses.

Comments from NOSSA

1. ***Comment**: It is stated on page 3-2, paragraph 3.2.2 that a buffer area of 25 feet along each side of the roadway will be cleared of MEC. Table 4-1 indicates a buffer of 50 feet. While 25 feet on each side of the road equals 50 feet in total for the buffer, the information could be misinterpreted to mean 50 feet on each side of the road. Suggest changing Table 4-1 language to reflect 25 feet on each side of the road for the purpose of consistency.*

   Response: The description of the roadway MEC clearance has been changed to read:

   "244 acres of roadways (including 25 ft buffer on both sides of the road) would be cleared of MEC to the depth of detection."

Comments from UXO Pro/PREQB

1. ***Comment:** Page 2-17, Section 2.5.3, Line 28 - This section says the vehicle traffic in the LIA and ECA will be "minimal" in the future. This is probably correct, but it may be possible to more accurately describe the future vehicle traffic by saying vehicle traffic will be "restricted to USFWS vehicles carrying persons and equipment performing wildlife management functions and to Navy contractors during site cleanup activities."*

   Response: The sentence has been changed to read:

   "The LIA and ECA are designated a Wilderness Area and therefore, public access will be prohibited and vehicle traffic in this area will be restricted to USFWS vehicles carrying persons and equipment performing wildlife management functions and to Navy contractors during site cleanup activities."

2. ***Comment:** Page 3-2, Section 3.2.1, Lines 12 and 13 - This section describes reducing hazards from energetic materials for, "recreational site users, USFWS wildlife refuge site workers, and other authorized personnel/workers, …" It is recommended that this list be expanded to include trespassers who are documented as being exposed to the hazards of MEC in Section 2.3.2, Lines 12 – 14.*

Response: Trespassers have been added to the list of people that will potentially have access to the site.

3. ***Comment:*** *Page 4-2, Section 4.1.2, Lines 9-11 and Page 4-3, Section 4.1.3, Lines 32-34 - Both of these sections contain the sentence, "In addition a long term monitoring and maintenance program would be required to assess if future erosion of the beaches would potentially expose MEC at a shallower depth than previously cleared." This is somewhat difficult to understand. It is recommended that this sentence be changed to, "In addition, a long term monitoring and maintenance program is required to assess if the amount of sand overburden on the beaches is reduced by natural erosion. This may have the effect of moving the surface of the beaches closer to the remaining MEC thereby placing the remaining MEC into the zone of future intrusive use. This condition may need to be corrected by additional removal action."*

   Response: The sentence has been changed to read:

   "In addition, a long term monitoring and maintenance program is required to assess if the amount of sand overburden on the beaches is reduced by natural erosion, as erosion of the beaches may create a potential MEC exposure pathway."

4. ***Comment:*** *Page 4-9, Section 4.3.3, Line 23 - This line says, "Alternative 3 would be technically more feasible than Alternative 3 ….". This second reference to Alternative 3 should be to Alternative 2.*

   Response: The second reference to Alternative 3 has been changed to Alternative 2.

5. ***Comment:*** *Page 6-1, Section 6.0, Line 15 - This line says, "Risks cannot be removed because of the limits of current geophysical technology to detect MEC." It may be more correct to say, "Risks from MEC cannot be completely eliminated at any site because of the limits …".*

   Response: As suggested, the sentence has been changed to read:

   "Risks from MEC cannot be completely eliminated at any site because of the limits of current geophysical technology to detect MEC."

Comments from USEPA

General Comment:

It is a generally accepted statement that over ninety percent of the MEC recovered during removal actions conducted at military facilities of the Department of Defense are located on the surface and in the first two feet (24 inches) of intrusive investigation. The Army Corps of Engineers notes in the graph displaying this information (EM 1110-1-4009, Ordnance and Explosives Response) that, "The database used to develop this graph was populated predominantly with UXO items typically used by or in close support of ground troops. Large naval ordnance and large aerial bombs are under-represented." While this under-representation does have an effect on the average depth of impacted munitions, there is no reason to expect this number to vary by more than ten percent at VNTR. In fact, Section 2.4.2, Nature and Extent of Munitions and Explosives of Concern (page 2-15) notes that, "Approximately 97 percent of the MEC items identified were found to occur within 7 inches of the ground surface." However, Table B-1, Detailed Cost Estimate, Alternative 2 Removal to Depth of Detection, contains a footnote that states, "Assume maximum removal depth of 6ft for 15 % of anomalies…"

These apparently conflicting statements raise some concerns as to the depths at which the Navy expects to find MEC and related scrap during the removal actions to be conducted based on this EE/CA. For example, Table 4-1, Alternative 2 – Removal of Surface and Geophysically Detected Subsurface MEC from Selected Roadways and Beaches to Detection Depth (page 4-2), estimates that 90 tons of scrap metal and 35 tons of MEC would be removed by the execution of this alternative. Table 4-2, Alternative 3 - Removal of Surface and Geophysically Detected Subsurface MEC from Selected Roadways and Beaches to Anticipated Depth of Intrusive Activity (page 4-4), estimates that 60 tons of scrap metal and 20 tons of MEC would be removed by the execution of this alternative.

Comparison of the quantities of MEC and scrap estimated to be removed by the two alternatives results in the following:

- *Alternative 3 will result in an estimated 15 additional tons of MEC being left on/under the surface of the roadways and beaches when compared with Alternative 2.*
- *Alternative 3 will result in an estimated 30 additional tons of scrap being left on/under the surface of the roadways and beaches when compared with Alternative 2.*
- *Alternative 3 will leave in place approximately forty-three percent of the MEC that would be removed by Alternative 2.*
- *Alternative 3 will leave in place approximately thirty-three percent of the scrap that would be removed by Alternative 2.*

It would appear from the above that the Navy expects the MEC distribution by depth to be significantly different than that outlined in EM 1110-1-4009. It would also appear that the Navy believes that the selected alternative will leave 15 tons more MEC behind on/in the beaches and roadways than Alternative 2. Please expand appropriate sections of the Draft Beaches & Roadways EE/CA to discuss the basis for this difference and the methodology used to determine the MEC and scrap quantities provided in the cited tables. Revise the conflicting sections/tables cited to make them consistent. In addition, please explain why leaving an estimated 15 additional tons of MEC in place on the beaches and roads is an acceptable result with the selected alternative.

Response: The statement attributed to EM 1110-1-4009 indicates that the data used to support that 90 percent of UXO is found within the top 2 ft is predominantly from "*UXO items typically used by or in close support of ground troops*." The depth to which the various ordnance pieces can penetrate the ground depends on how the ordnance is deployed, the type of soil, and the type of ordnance. Therefore, it is not reasonable to expect a hand grenade thrown by a soldier to penetrate the ground to the same depth as a bomb released by a plane. While the Navy does anticipate finding the majority of the MEC and scrap metal on the surface and within the first 2 ft of soil, we also need to be able to anticipate finding items deeper than 2 ft, as that will affect the cost of the removal action.

The 15% of items requiring a maximum removal depth of 6 ft cited in Table B-1 is used as a means for adjusting the cost of the removal action. This is a conservative estimate because the effort required for the UXO technicians to identify and recover MEC at 4 ft is significantly less than that to identify and recover MEC from 6 ft (excavations exceeding 4 ft demand additional engineering controls and health and safety requirements that will slow the investigation process); the cost to conduct this work is directly proportional to the amount of time and effort it takes to recover the items. This adjustment/decrease in production rate is stated in the footnote: "Assume: maximum removal depth of 6 ft for 15%

of anomalies, engineering controls will be used for excavations, which will reduce production rate by 1 acre/week relative to Alternative 3." While 15% of the ordnance found may not require removal to 6 ft, this is a reasonable, conservative means of adjusting the estimated cost to account for the additional labor necessary to complete the work. This percentage is not meant to serve as a definitive distribution of MEC in the roadways and beaches.

While Alternative 3 is anticipated to leave potential MEC in the subsurface, it is equally effective as Alternative 2 in meeting the removal action objectives stated in Section 3.2.1 of the EE/CA. Under the proposed future land use scenarios, the proposed removal action is adequately protective of human health and the environment. The EE/CA is for an interim removal action and the Navy realizes that the site conditions are dynamic and future erosion may potentially result in MEC being closer to the ground surface. As a result, the final remedial action may need a monitoring plan and land use controls to minimize potential MEC explosive safety risks. The statement given in Section 2.4.2 regarding depth of MEC items is for SWMU 4 on West Vieques, which is a former OB/OD area and would be expected to have much shallower depth of subsurface MEC. The findings from SWMU 4 cannot be extrapolated to the former VNTR because of the significantly different munitions use.

Specific Comments

1. ***Comment:*** *Section 2.4.1, Preliminary Range Assessment, page 2-10: In line 30, this section refers to "two MEC storage areas." Please review the two cited areas and determine if they are actual MEC storage areas, or if they are munitions or explosives storage areas. Correct the titles of these areas if necessary.*

   Response: The two MEC storage areas referenced are Photo-Identified Site 9 (PI-9 East) and PAOC-EE. PI-9 East, located near the southwest corner of the EMA, was identified from the review of historical aerial photos from 1959 and 1962 that showed bermed areas where there was open storage of munitions with a large trench at the northern end on the site. PAOC-EE, identified by the review of historical aerial photographs and through interviews during the environmental baseline study, was the location of munitions storage within earthen berms. The text has been revised to read "two munitions storage areas"

2. ***Comment:*** *Section 2.4.2, Preliminary Assessment/Site Investigation, page 2-13: This section uses the term "MEC/UXO" in a number of instances. As UXO is a sub-element of MEC, this usage is redundant. Please replace "MEC/UXO" with "MEC."*

   Response: MEC/UXO has been replaced with MEC.

3. ***Comment:*** *Section 2.4.2, Preliminary Assessment/Site Investigation, page 2-15: The term ""buried" is used here to refer to items found in the subsurface of an 87-acre area. It is unclear whether these items were purposely buried or are simply items located beneath the surface of the area. Please review the status of the items and change the descriptive term to subsurface unless the items were actually buried by individuals. This correction should also be made elsewhere in the document when subsurface items not intentionally buried are so described.*

   Response: "Buried," as used in this report, is meant to describe items found below the ground surface. It is assumed that the metallic objects detected in the subsurface are

there due to the use of the site as a live training range and have been incidentally covered by soil. However, the term "buried" implies that the items were intentionally placed at a specific location and covered with soil. Since the term "subsurface" applies to all objects detected below the ground surface, whether there intentionally or not, "buried" has been replaced with "subsurface" throughout this document.